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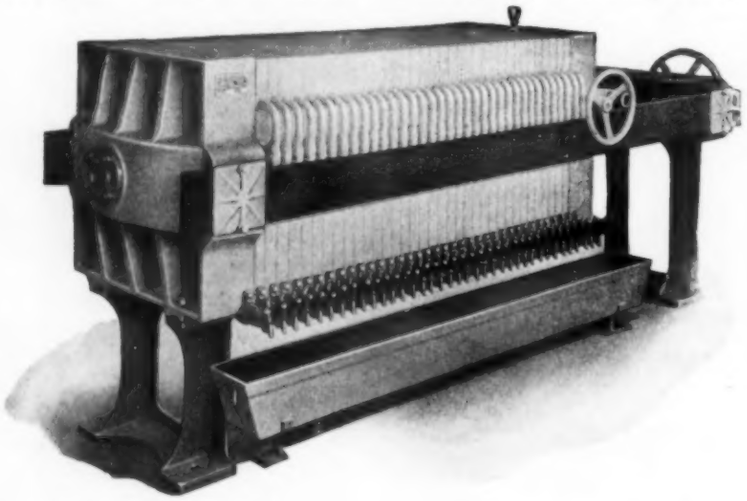

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Editor

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Research Upsets An Industry And Captures a Market

IN THE importation of German synthetic methanol at a price, with duty, about half that of the domestic natural product, American chemical industry is being treated to a classical demonstration of the far reaching industrial consequences and commercial value of scientific research. Based on the fundamental work of college professors and researchers in pure science, German industry has developed a product that has demoralized our domestic methanol market and threatens to disintegrate our wood chemical industry. It is not the first time that German devotion to research has paid its dividends in industrial supremacy and upset the established order of things.

THERE has been a tendency in some quarters to decry this development as a studied assault upon American chemical industry and to regard it as one more bit of evidence that Germany is determined to regain her chemical domination of this country and reduce it to a state of scientific vassalage. The sentiment leaves us cold and unmoved. With the desire and determination to make the United States chemically independent and self supporting we have the deepest sympathy and have directed the full force of our influence toward that goal. Moreover we have confidence that it can be done. But we have believed and constantly preached that it is to be accomplished not by pleading the cause of patriotism, repelling the invader and excluding his products, but by the active exercise of our scientific knowledge generously supported by money. It avails nothing to shout patriotically and rally to the flag if meantime our brains lie dormant and our treasuries resist the appeal for funds.

RATHER than weep over the present situation and lament our future state, American chemical industry should heed the lesson and busy itself. What other vulnerable spots do we offer to our competitors? What other products and processes are amenable to improvement? What new areas of research and investigation should be more intensively cultivated? A monopoly on brains and ability is given to no people, but industry and preparedness must be exercised by those who expect to win. The fable of the hare and the tortoise, and the parable of the wise and foolish virgins are just as applicable now as when they were uttered. They represent fundamental truths that should spur us on to enlarged programs of research. They charge us to put our faith in science and engineering rather than in artificial barriers. If love laughs at locksmiths, research makes even more scornful gestures at tariffs and other economic stimulants.

THE area of physical chemistry in which Germany has achieved this striking success—catalysis under pressure at high temperature—offers a wide and fertile field for research. Of chemical reactions at high pressures and temperatures we know comparatively little, but the achievements of the past decade in petroleum cracking, nitrogen fixation and production of synthetic methanol are enough to indicate the great industrial opportunities awaiting discovery in this field. But they will be revealed only to those who search diligently; the reward will come only to those who back their faith with funds.

AMERICAN industry is still characterized more by efficiency in mass production than by refinement in methods of research and investigation. As long as this is true we may expect occasional surprises by those who work perhaps more slowly and laboriously but also more fundamentally. Gradually we shall gain in knowledge and appreciation of the fact that research lies at the foundation not only of the chemical industry but also of all the ramifications of industry in which chemical engineering plays a part.

Commission Tackles Muscle Shoals

THE next chapter in the history of Muscle Shoals will be written by a Presidential Commission. It is too much to hope that it will be the final chapter because the commission is appointed merely to advise Congress as to the best disposition of that much debated property. And Congress has frequently shown itself quite unwilling to take advice on technical matters of which it knows least.

It has been our feeling for some time that an investigation and report by a competent board of engineers would give the Government the necessary facts on which to base a sensible program. But we did not contemplate the appointment of a commission with engineers in the minority and dominated by politicians. This makes the outlook less hopeful, though there is sufficient courage and independence of thought and action in the chemical engineering member of the commission to justify the belief that he will exert more than his share of opinion in drafting the final report.

The economic and technical status of the nitrate plants at Muscle Shoals has changed several times during the past six years; and with the developments in nitrogen fixation now going forward it is not inconceivable that the status may change again in a short time. In fact it is not wholly out of the question that Congress will so long delay disposal of the property that it will have no greater industrial and technical significance than some of the other great war-time plants that were sold or scrapped without debate at a fraction of their cost. Hence the necessity for prompt action by Congress after the commission reports.

Hysteria Rampant

A FEW weeks ago an innocent looking press dispatch from Geneva announced that Dr. H. Zangger, professor of legal medicine at the University of Zurich, found an indictment against the American petroleum industry, charging particularly that ethyl gasoline was a menace to health in Zurich and other European cities. The immediate cause of the Doctor's perturbation was that he had "analyzed street dust in Zurich and found it impregnated with brome and tetra ethyl of lead (*sic*) which had been thrown out by motors into the air and had settled upon the ground." Of course bromine and tetra ethyl lead may perform differently for a professor of legal medicine than for ordinary chemists, but it is difficult to believe that even so eminent a scientist as the Herr Doktor Zangger would not encounter some difficulty in exploding ethyl gasoline in a motor and finding tetra ethyl lead in the exhaust. Likewise it is difficult to visualize bromine falling to the ground and impregnating the city's dust. In order to set up a substantial strawman, and one worth knocking down, the learned doctor "estimates that thousands of pounds of this dangerous dust of lead oxides are deposited yearly on the principal streets of Zurich and other European cities to menace public health." It would have been far more original and no farther from the truth if the Doctor had speculated on star dust from interstellar space as the source of his bogey.

Facts and figures could have been discovered by Dr. Zangger had he been minded to investigate, but they would have disillusioned him and consequently would not have supported his hysteria. It is true that over 300,000,000 gallons of ethyl gasoline have been sold, but practically all in the United States. A few pounds of tetra ethyl lead have been exported to several European countries for research and patent purposes but it is doubtful if more than 50 pounds of ethyl fluid ever reached Geneva, all of which discredits the Doctor's estimate that thousands of pounds of lead oxide is deposited yearly in the streets of European cities. Moreover, there is apparently nothing startling about the discovery of lead in city dust. Our own Bureau of Mines recently collected and analyzed dust from 10 American cities in some of which ethyl gasoline was sold while in others it has never been used. Small quantities of lead were found in all the samples tested, but those from cities in which ethyl gasoline was sold carried no more than the others. Dr. Zangger would have the Zurich authorities prohibit the use of the "death-dealing liquid" in which respect he is not unlike one or two alarmists in this country who, however, find it difficult to gain aceptance for their opinions. Whatever the motive and inspiration for the Doctor's propaganda it is so fanatical as to fall of its own ridiculous weight. We suggest that he address himself to the recovery of lead in Zurich street dust.

Patent Office Transfer Gives Closer Contact with Industry

PRESIDENT Coolidge's order transferring the Patent Office from the jurisdiction of the Department of the Interior to the Department of Commerce came as a surprise to many, but to industry it was a welcome change in the government organization. It certainly insures a closer contact between that important government office and the industries which it should serve. Moreover it places the patent system under the direction of Secretary Hoover, that most sympathetic public official in all matters affecting commerce and industry.

No changes are contemplated in the personnel of the Patent Office under its new departmental control. There is no doubt, however, that it will receive more active encouragement and cordial support in the industrial and business atmosphere of the Commerce Department. It has long been out of place among the wards of the nation, having no remote resemblance to the problems of public land control, the management of Indian affairs, care of the insane, or administration of the pension laws.

At the very outset Mr. Hoover has announced his intention to take up our problems of international relations with respect to patent rights, copyrights and similar trade conventions. In these fields the American inventor and American industry have long been at a disadvantage because of working clauses in the patent law of other nations. Such regulations frequently make it necessary for American manufacturers to maintain factories abroad in order to protect their patent rights. But this nation makes no corresponding restriction upon the foreign manufacturer and he can produce where he will, dumping his product of underpaid labor upon the American market in direct competition with American producers who cannot take advantage of similar economies. This and many other problems will engage the Department's attention. The outlook is therefore a most pleasing one both to the patentee and all industry concerned with patents.

Making Oleomargarine More Like Dairy Butter

SOMETIMES we wonder if the oleomargarine industry is in the control of the dairy farmers, so slow is the introduction of reform and so disinterested do the producers appear to be. From several points of view, the substitute butter manufactured in the United States is a success; but as a convenient "spread" it is a dismal failure. European oleomargarine can hardly be distinguished from dairy butter, a similarity that is claimed in some quarters to be possible of achievement because of the more equable climate, with narrower temperature variations. In the United States, however, most of the substitute butters have none of the physical characteristics of the dairy product, even after coloring has been added. To the frugal housewife the use of the cheaper product is a perpetual source of bother. At normal temperatures it is hard and difficult to handle; it never cuts like butter. The result is that oleomargarine finds acceptance only among those who are forced or willing to put up with its many shortcomings. Has research on improving the physical characteristics of oleomargarine come to an abrupt and unpromising end? We do not think so. In fact, it seems to be an accepted fact that an oil can be produced in which the content of mixed glycerides is such as to insure a wider range of melting points. The increased cost of such an oil, as compared with the cost of the raw product from which the commercial oleomargarine is made, is so insignificant that it is inexplicable that there is opposition to its use. Further discussion on the technology of oleomargarine would be welcome.

Government Loses Its Suit Against Chemical Foundation

IF THE decision of the Circuit Court of Appeals dismissing the Government's suit against the Chemical Foundation failed to cause more than a ripple of excitement in the chemical industry it was due not so much to a lack of vital interest in the outcome as to a foregone conclusion on the Court's opinion. Anyone who had followed the carefully prepared defense of the Chemical Foundation in the District Court, and the equally logical and well-reasoned opinion of Judge Morris dismissing the suit and criticizing the Government for many of its allegations, could not but believe that the Chemical Foundation would again be vindicated in the Appellate Court.

The court's opinion, written by Judge Wooley, displays an exceptional comprehension of the relation of organic chemical industry to national welfare. As a legal document it must command the admiration of laymen as well as the profession for its careful analysis, logical deduction and clarity of expression. In brief, the court found none of the Government's allegations sustained by evidence. The sale of the German patents to the Chemical Foundation was carried out in full conformity with the law; and the Chemical Foundation, Francis P. Garvan, Joseph H. Choate, A. Mitchell Palmer and others were exonerated of any suspicion or guilt of conspiracy in engineering the sale.

While the details of the court's opinion need not be given here, it is worth while elaborating one point on account of the wide misconception that prevailed regarding the power vested in the Alien Property Custodian. As originally enacted when the United States entered the war, the trading with the enemy act contemplated the seizure of enemy property as a conservation measure and gave to the Alien Property Custodian only the power of a trustee. Seized enemy property, thus became a trust, and it was the contention of the Government that such property could not be confiscated. Before the end of the war, however, on March 28, 1918, Congress amended the trading with the enemy act in the following significant language with respect to the powers of the Alien Property Custodian:

> "and in addition thereto [that is, in addition to the powers of a common-law trustee], acting under the supervision and direction of the President and under such rules and regulations as the President shall prescribe [the custodian] shall have power to manage such property and do any act or things in respect thereof or make any disposition thereof or of any part thereof, by sale or otherwise, and exercise any rights or powers which may be or become appurtenant thereto or to the ownership thereof, *in like manner as though he were the absolute owner thereof:* Provided, That any property sold under this act, except when sold to the United States, shall be sold only to American citizens, at public sale, to the highest bidder, after public advertisement of time and place of sale which shall be where the property or a major portion thereof is situated, *unless the President stating the reasons therefor, in the public interest shall otherwise determine.*"

In the opinion of the court "it is evident that by this amendment Congress transformed the trading with the enemy act from a purely conservation measure to one of action, definite and drastic." It was thus wholly within the President's power to direct the Alien Property Custodian to sell the seized German patents, and to consummate the sale privately "in the public interest." Thus a point which has genuinely disturbed some sincere souls who felt that the sale was illegal and beyond the intent of Congress is cleared up without doubt or cavil. While the Government has not yet announced its decision with respect to an appeal to the Supreme Court it is to be hoped that it will abandon any such intention.

Chemical Research Reveals New Use for Tellurium

TELLURIUM is a metal of limited application. It lies unrecovered in immense available amounts, awaiting the call to useful service—a call that could only come as the result of intensive and successful research. Chemistry now bids fair to bridge the gap between production and consumption. Strange as it may seem, the metal is likely to find an important place as the base for an unusually efficient germicide, insecticide, fungicide and preservative of wood. Selenium, it may be added, would play the same rôle; but tellurium seems likely to claim major attention.

The toxic character of a colloidal solution of tellurium is recognized, and much research has been done in an effort to develop the idea to a stage indicating the possibility of successful commercial utilization. It has remained, however, for C. Dickens, a graduate of Bradford Technical College and the University of Leeds, England, to utilize barium sulphide in the preparation of a new type of colloidal tellurium, the result being a product of unusual characteristics and properties. The

idea resulted as a sequel to prior research with radium ores containing barium.

The method of preparation of the new colloid, for which a United States patent has been allowed, is extremely simple. Tellurium is quoted nominally at $2 per pound, an amount sufficient to make 500 gal. of concentrated product. As a "sticker" and a "spreader" the solution appears to be remarkably effective. On exposure to the air it oxidizes and becomes insoluble. Various modifications in preparation are proposed, including the use of a protective colloid such as calcium caseinate.

A government agency is making experiments to determine its value in the campaign against the boll weevil. Selenium-treated piles are undergoing test in San Francisco Bay to demonstrate whether the ravages of the destructive *Teredo navalis* can thereby be held in check. Experiments are being made to demonstrate its value in the preservation of wood subject to attack by white ants. The scope for application of a new colloid of this character would appear to be unusually wide, and the results of the investigations are being awaited with interest. There is promise that chemistry will again serve the dual purpose of utilizing discarded raw material and preventing destruction and waste.

Chemical Engineering Invades the Hen Coop

AMUSED interest followed the announcement a few years ago that egg production can be increased when the natural illumination of the hen coop is supplemented by artificial light. Short days were thus made longer; dull days were made bright for the hens. Acetylene found wide application as an illuminant, particularly because the residue was available for the local manufacture of an excellent whitewash. More recently, systematized thought and well-directed research have pointed a way to the stimulation of output by an occasional subjection of the hen to the remarkable effects of ultra-violet rays. Production is thereby quadrupled, it is maintained. Where will this indecent persistence of science end?

With a probable increase in production, steps must be taken to stabilize marketing, and this can only be done effectively by applying the inventive genius of the chemical engineer, rather than by accepting as final the assumption that eggs must be used fresh, or kept in cold storage or in preservatives. The drying of eggs is chiefly a Chinese industry. Although a duty is imposed on the imported product, this does not prevent the consumption of a large quantity in the United States, where it competes with domestic food products manufactured under stringent government supervision and regulation. Imported dried egg may be, and probably is, produced under conditions that would not be tolerated in any food-product manufactory in this country. The competition is therefore an unfair one, and the anomaly can only be counter-balanced by the development of a high standard of research in this country, and the full utilization of inventive genius.

It is therefore interesting to note that since we wrote a few weeks ago on the subject of the dehydration of foodstuffs, a remarkably ingenious machine has been put into successful operation at San Francisco for the drying of egg albumen, yolk or mixed product. This is due to H. Kennedy, and the co-operation of E. C. Benner, C. E. Barnhill and the Poultry Producers of Central California. A large number of rotating disks of screening pass continuously into a bath of warmed, circulating product, and a covering film is thereby taken up. A traveling mechanism then takes these through a drying chamber in which accurate temperature control is maintained by the operation of electric heaters and fans. At the discharge end of the apparatus the screens come in contact with wire brushes actuated with a jigging motion. The dried egg, in granules, falls into a receiving hopper, and the screen disks pass on for immersion in the egg bath. Operation is continuous and automatic.

It is interesting to reconstruct a few of the steps that led to the development of this machine. The advantages of electric heating and mechanical control were recognized, thereby insuring precision of temperature maintenance and the absence of combustion byproducts. The availablity of reliable temperature control and recording instruments played an important part. A comparatively immense surface of egg film was necessary, to insure compactness of equipment and economy of fuel. As with filtration, the disk-type machine proved attractive. The success of this new development indicates the value of a broad catholicity of interest in technical developments on the part of industrial consultants. The field for research of so practical and beneficent a nature is almost unlimited. The chemical engineer is well equipped for such work.

Increasing Capacity Of Unit Devices

WITH the constantly increasing demand for city gas, engineers in the manufactured gas industry have been confronted with the problem of greater plant capacity. The manufacturer has shown a decidedly progressive spirit in handling this situation for he has not been content to take the easy route of adding more gas machines. He has taken the better method of increasing the capacity of existing units.

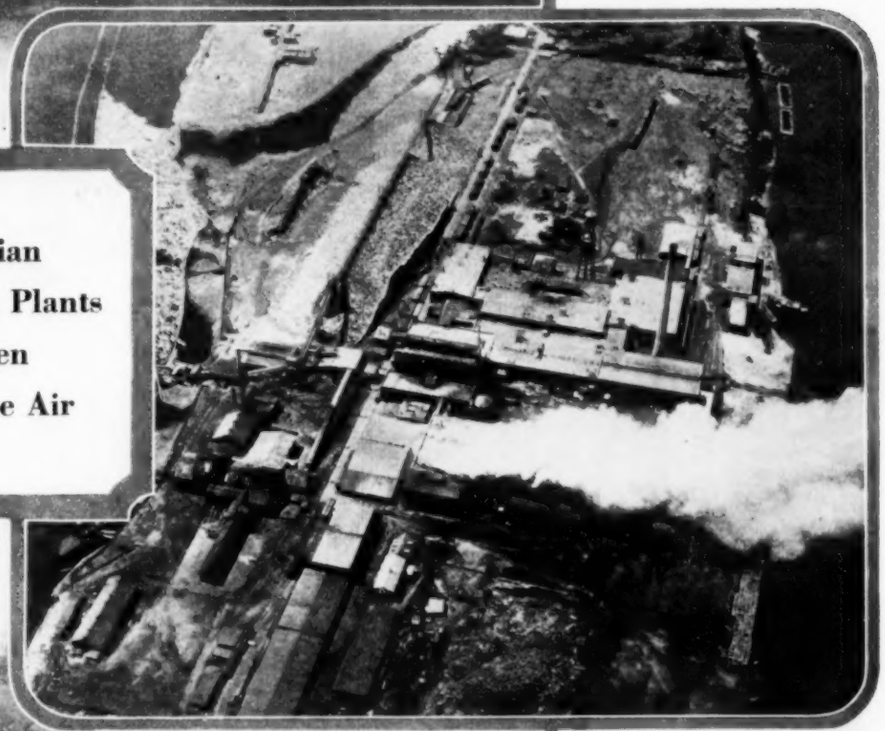
One of the important means by which this end has been accomplished is the use of automatic control equipment. Practically all water-gas machinery builders now supply these automatic devices. They were at first developed principally to cut labor cost, but not the least of their advantages has been the shortening of waste time in the operating cycle. By reducing the interval between gas making periods through quicker shift from "blow" to "make" and back again the output on each shift has been materially increased. In some cases this has made it unnecessary to add new machines because the old with the increased rate of output could easily carry the peak loads.

In other chemical engineering industries the same problem must be met and the same solution should be seriously considered. Reducing intermittent and batch operations to automatic routine will often save within a few months the total cost of new control equipment needed to make this possible. And where the increased capacity postpones the time when new unit devices must be added, the conservation of investment is likely to be large right from the start. If the water gas manufacturer has accomplished this doubtless many other simpler operating cycles can be similarly improved. Gaining plant capacity by adding more units is the easiest way, but often it is not the best.

Canadian Newsprint Plants as Seen From the Air

AT RIGHT — *Plant of the Wayagamack Paper Co., on the St. Lawrence River at Three Rivers, Quebec, Canada.*

BELOW — *Newsprint plant of the St. Maurice Lumber Co., located at Three Rivers, Quebec, Canada.*



ABOVE — *The Belgo-Canadian Pulp & Paper Co. plant located at Shawinigan Falls, Quebec, Canada.*

AT LEFT — *Another newsprint plant at Three Rivers, Quebec, Canada, owned by the International Paper Co.*

Development of Equipment for Making Ground Wood Pulp

Rapid Progress in Design of Machines and Control for the Production of Mechanical Pulp Has Occurred During the Past Twenty-five Years

By J. F. Clerc
Escher Wyss & Co., Zurich, Switzerland

THE production of wood pulp for paper-making by grinding alone, without chemical treatment, originated in Germany about 80 years ago and was introduced into the the United States in 1876. Until the close of the 19th century little progress was made in this process. Methods used were empirical and little attention was paid to the different factors by means of which quality of pulp, power consumption and production can be controlled.

In the first patent, granted to Henry Voelter in Saxony on Nov. 20, 1846, the method of grinding is described as follows: "By means of a clamping device and lever, I press the logs against the revolving grindstone in a position parallel to the shaft of the latter, whereby they are transformed into a fibrous pulp." This shows that Voelter's design was essentially the same as that used at the present time. In fact, his first grinders were built along lines similar to the pocket grinders of today. They consisted of a grindstone mounted on a horizontal shaft and a number of radially arranged pockets in which logs were guided and pressed against the circumference of the stone. The feeding system, entirely mechanical, was driven from the main grinder shaft by chain, friction and gear drive.

With this grinder, great variations in the speed of the stone occurred when one of the pockets was emptied and had to be refilled. To overcome this, a system was devised by means of which the feeding speed on the remaining pockets was increased during this period.

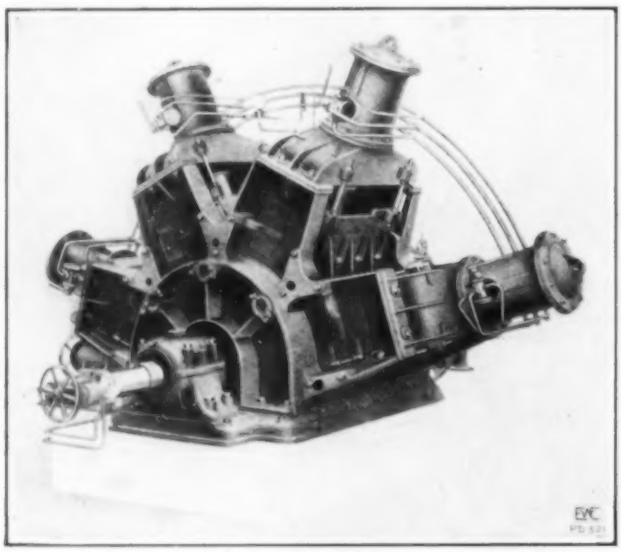


Fig. 1—Pocket Grinder for Logs 40 Inches Long
While pocket grinders consuming up to 1,000 hp. are often seen in Europe, they have never become very popular in the U. S. A. and Canada. These large pocket grinders have, however, been found to give as low a labor cost as magazine grinders

This control was obtained from a fly-ball governor which shifted the belt driving the feed mechanism over 2 cone pulleys.

An important modification of the feeding mechanism was made in 1887. This, an American design, consisted of providing hydraulic cylinders, the pistons of which operated rams in the grinder pockets. The machine

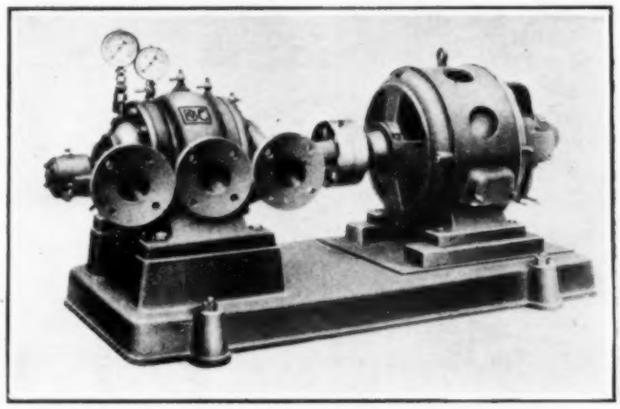


Fig. 2—Pump for Use With Pocket Grinders
This pump has two deliveries, one for low pressure water for the reversing and compressing motion and the other for high pressure water for the actual grinding

itself was also somewhat simplified in its operation. This new design spread rapidly and gave to pocket grinders their present typical appearance.

Despite the fact that, with this hydraulic feed, the grinding pressure could be varied easily and that experiments could be carried out without any particular trouble or expense, the influence of grinding pressure was not studied generally until much later. Most mills continued to work in an empirical way. Two widely different routines were developed. In Europe it was customary to add a large amount of water to the stock during grinding, so that the stone was kept cool and the stock, in a highly diluted condition, flowed freely away from the machine. In America the amount of water used was reduced to the minimum, the stock was kept back and dammed up so that the stone would dip into it and by friction produce a temperature close to the boiling point.

Tests were carried out from 1896 to 1898 by the late Prof. E. Kirchner of Chemnitz, in order to determine which of these methods produced the best pulp. He proved conclusively the superiority of the American method, which has since then been almost universally adopted. As far as is known, this was the first time that all the different factors and relations involved in the grinding process were studied in a systematic way and Kirchner may therefore truly be given the credit of creating the "science" of wood grinding. The im-

Fig. 4—Part of an Installation of 51 Three Pocket Wood Grinders

This view clearly shows the inconvenience that results from an installation of many small grinding units. The congestion caused by the stock piles at each machine is such as to seriously interfere with efficient operation

portance of his work cannot be overestimated. He took the manufacture of ground wood pulp out of the realm of empiricism and made it clearly systematic and scientific, laying down fundamental rules and laws that have so far held.

Equipment Is Redesigned

Not only the pulp manufacturers but also the makers of grinding equipment profited from Kirchner's work. They redesigned their machines to meet the conditions that he laid down for efficient work. Speed of the stones, grinding pressure and machine size were increased. From 1900 on we enter the period of high capacity grinders with single units consuming 800 to 1,000 hp. and grinding logs of 3 and 4 ft. length. Such a machine is shown in Fig. 1.

As the units increased in size, the necessity of efficient regulation became very urgent, since, when reversing a press for refilling, load variations of 25 to 33 per cent (as high as 300 hp.) occurred. These variations caused inefficient power utilization and high momentary overspeeds that eventually resulted in heavy

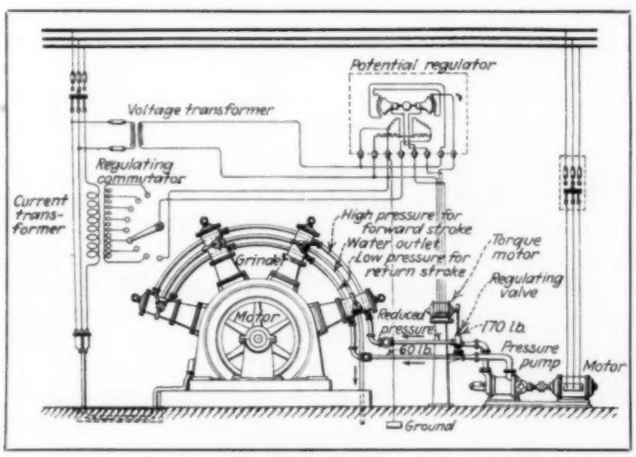


Fig. 3—Diagram of Automatic Regulation System for Pocket Grinders

This diagram shows a system for 1 or more machines. The load on the stone is controlled by a torque motor acting through a throttle valve on the pressure water system. The voltage fluctuations are regulated and a regulating commutator in the torque motor circuit gives 8 different power steps in the main motor regulation. The pressure system is the most perfect and simple at present available when using the pump shown in Fig. 2

breakage losses of stones. The first practical solution of the difficulty came in the system patented in Europe by J. M. Voith, Jr. In this arrangement the pressure in the hydraulic cylinders is controlled by a throttle valve which in turn is controlled by the demand on the motor. As the load slacks off, due to a pocket emptying, the pressure of the other pockets is increased sufficiently to maintain a constant brake effect on the stone. In order to avoid a drop in the grinding pressure during the fast return motion of a piston immediately before refilling, a hydraulic accumulator or air chamber is provided to allow for this momentary increase in pressure water consumption. This device has, since its first appearance, been changed so that the water from the accumulator is also used for the first part of the forward stroke, during which the wood is compressed until grinding pressure is reached, the water passing through the throttle valve being used only for the actual, and comparatively slow, grinding stroke during which the pressure water consumption is small. On turbine-driven grinders the throttle valve is controlled by a mechanical governor reacting on speed variations in the prime mover, while for motor-driven machines a small torque motor is used. In both cases steadiness and stability is obtained by means of dashpots.

Recently, centrifugal pumps have replaced reciprocating pumps for supplying pressure water, because, while they take a small amount more power, they occupy less space, need less attention and can be direct driven from motors. Fig. 2 shows a combination pump of the extraction type that is used for this service. The pump has two discharges, one supplying low pressure water in greater amount for the reversing and compressing motion and the other covering the consumption of high pressure water for the actual grinding.

Fig. 3 shows a simple and efficient arrangement for pocket grinder regulation of recent design. In this design, variations in the consumption of low pressure water do not affect the high pressure and therefore the pumps can be connected directly to the grinders without an accumulator. The simplicity of this layout is evident from the drawing, which is self-explanatory.

In America, practice has tended toward driving several grinders of medium capacity from one motor,

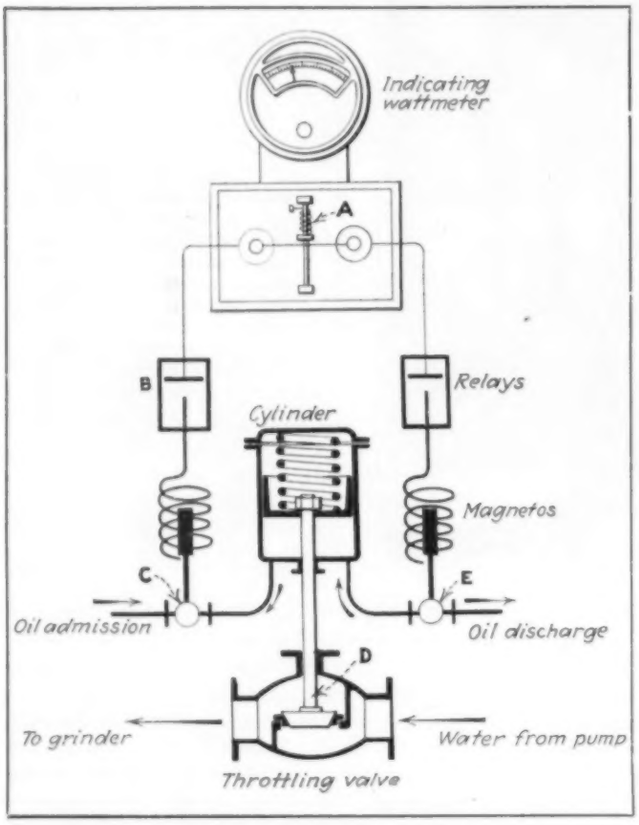


Fig. 5—Waterous Wattmeter Type Governor
This device, largely used in Canada, will hold the load constant even when variations in voltage or power factor occur. This adapts it to cases where power is purchased, because it insures good utilization of the contracted for amount of power

rather than using units of high capacity. This simplifies regulation because relative fluctuations due to the reversing of any one pocket are less. The load is kept constant by having the same number of pockets grinding at any time. To do this, a "check" pocket is used. This is started as soon as one of the regular pockets has ground down and as soon as the latter is ready again it is stopped. Many plants are still using this somewhat primitive system, which is not automatic and requires the constant attention of an operator. Mostly, also, water from the same source is used for the advance and return motion of the hydraulic pistons; and, of course, due to the great volume of water required for the quick reversing of a press there is always a consequent drop of pressure in the remaining presses. Fig. 4 shows a typical installation of 51 three-pocket grinders. The inconvenience of this arrangement, due to the many machines and the stock of logs at each, is evident.

Modern American Regulators

Accurate and efficient regulation not only improves the mechanical conditions, it also improves the pulp. The more uniform the grinding pressure, speed of stone and power consumption, the more uniform is the product. For this reason, many American and Canadian mills have been equipped with regulating systems. Some use the European type (throttle valve actuated directly by governor or torque motor) while others use systems developed in America.

The European regulators of the torque type work on the amperage drawn by the main grinder motor. As long as the voltage and power factor are constant, the amperage is directly proportional to the load. But there are always tendencies for fluctuation in the power factor and for this reason the wattmeter principle of regulator design is preferred in America.

One of the regulators used is the Waterous governor, shown by the diagram in Fig. 5. Its controlling element is a special type of Kelvin balance with movable coils wound for potential and stationary coils wound for current. The operation, referring to Fig. 5 is as follows: If the load falls off a spring overcomes the attraction of the coil (*A*), thus forcing the moving contact against the right-hand stationary contact. This energizes the left-hand relay (*B*), operating the admission valve (*C*). Oil from a pump is then permitted to flow into the cylinder, opening valve (*D*) and increasing the pressure on the grinder cylinders. The load is raised until the moving contact is once more swinging freely. If the load increases beyond that for which the governor is set, the oil discharge valve (*E*) will be opened by the other relay and the spring in the cylinder then forces the water valve down, reducing the load. A dashpot on the Kelvin balance steadies the action. A compensating device prevents over-regulating and "hunting."

The Westinghouse regulator, shown in Fig. 6, has a throttle valve actuated by a small reversible motor. The direction of rotation is controlled by a contact-making watt relay having current and potential coils like the Waterous governor. As long as the grinder motor is carrying the correct load, the balanced beam of the watt relay is floating between the contact points. In case of a decrease in load it will close the contact on one side, and through a relay, cause the motor (*A*) to rotate in such a direction as to screw upward the rod attached to lever (*L*). This lever is fulcrumed at the stem of the compensating piston (*M*). The opposite end moves upward and opens the throttle valve (*B*), admitting more pressure to the grinder cylinders and increasing the load on the main motor. As soon as this operation begins, some water from the pres-

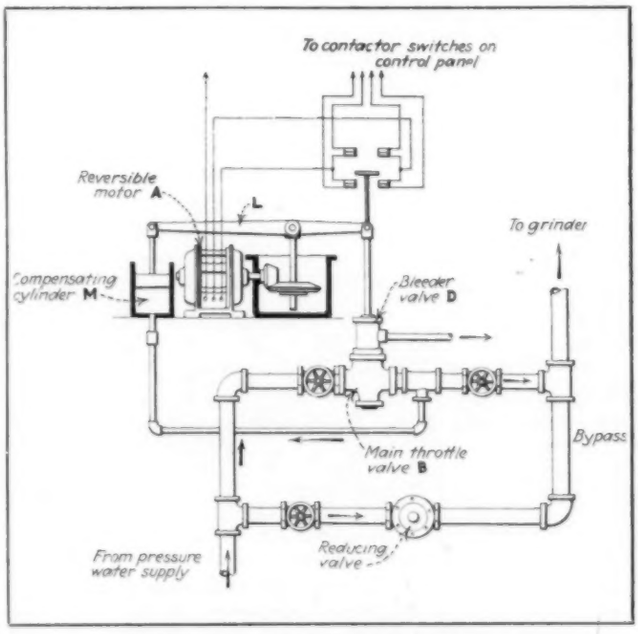


Fig. 6—Westinghouse Load Regulator
This regulator is found in many American mills using motor drive on their pocket grinders. It prevents all peaks and makes a uniform load curve. It consists chiefly of a watt relay controlling a reversible motor which operates the throttle valve. A bypass allows operation without the governor if desired

sure line enters the space below the compensating piston and tends to close the throttle valve again. Increase in load reverses the action just described. In addition, the bleeder valve (*D*) is opened between the main valve (*B*) and the pocket cylinders, relieving the pressure at once. Cut-out switches stop the regulating motor automatically when the throttle valve is either wide open or entirely closed.

Governing Hydraulic Turbine Drives

Water turbines, to use the available water power most efficiently, must run at the speed at which they have their greatest efficiency. Since this speed varies with the head and the head varies according to uncontrollable circumstances, the regulator used with a water turbine drive must permit an easy adjustment of speed between comparatively wide limits. The Meyer governor, probably the most used for this service in the United States and Canada, is such a device. The controlling member is again a throttle valve in the water pressure line, this time a balanced valve of the double seat type. This is operated by a diaphragm with water pressure on one side acting against a spring. Water

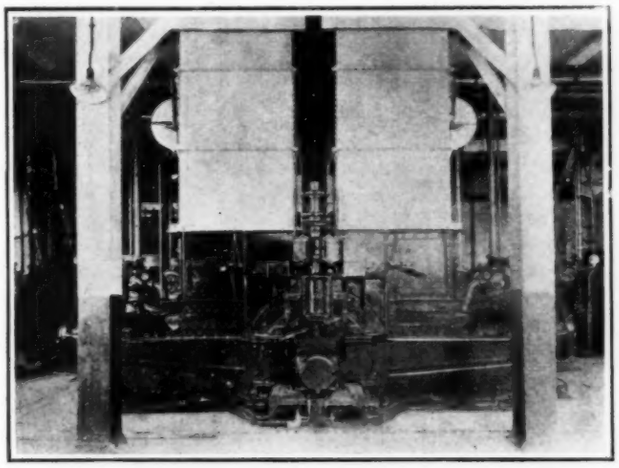


Fig. 7—Side View of a Magazine Grinder
This machine, unlike that described in the text, has two magazines, one for each pocket. To remove the stone, the plates and castings above it are removed and the magazines swung one to each side out of the way

pressure for the diaphragm is supplied by a small centrifugal pump, driven from the grinder shaft. Load variations therefore change the speed of this pump and operate the diaphragm up or down and, through it, the balanced valve opening is regulated. A spring arrangement prevents hunting.

Development of Magazine Grinders

In 1912 the most radical step in the development of wood grinders occurred, when J. M. Voith brought out the magazine grinder. Today, about 150 of these machines are in use, about 70 of them being in the United States and Canada. In this machine, a magazine of structural steel and steel plate holds the wood, centrally over the stone. On each side of the stone, in an almost horizontal position, is a wide pocket with hydraulic cylinder and pressure foot. During the backward stroke of the piston the pocket is filled with logs from the magazine by gravity. The hydraulic control valves for the presses are operated by levers moved by the pressure foot of the respective grinder pockets. As soon as the pocket is ground down it is

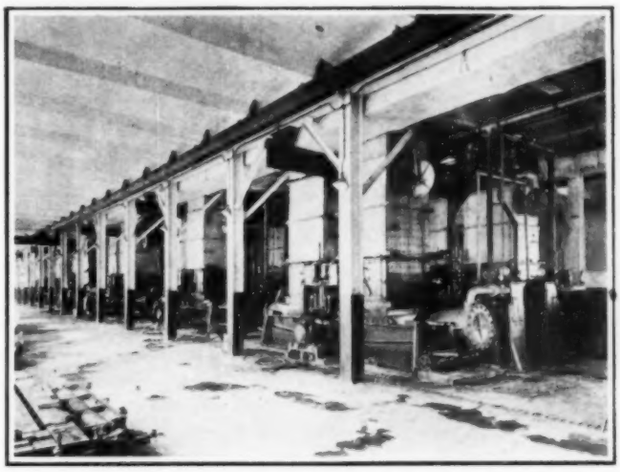


Fig. 8—Ground Wood Room of a Big Mill
In this picture, 14 two magazine grinders are shown, arrranged in pairs each pair driven by a 2,800 hp. motor. The timing device is contained in the vertical housings visible between the two nearest grinders

immediately reversed, rapidly filled and put back into operation, all automatically. The only manual labor required is on the charging floor, where a man keeps the magazine filled.

Magazine grinders can be regulated either electrically or mechanically according to the prime mover used. If only one machine is driven from a source of power the load variation during the refilling of a pocket is 50 per cent and hence the pressure on the other pocket must be doubled. To get away from this, 2 machines are usually driven from one motor or turbine, a timing device permitting the reversing of but one press at a time. This results in a more uniform product.

Continuous Grinders

One of the earliest endeavors of wood grinding equipment designers was to make a continuous machine that would give a uniform pulp. It was attempted to build the magazine so high that the pressure of the column of wood would give the necessary grinding pressure. Jamming and bridging of the wood in the magazine prevented this. However, as early as 1908 and 1910 patents were taken out in Europe by J. M. Voith for a continuous grinder in which wood was fed onto the

Fig. 9—Charging Floor for Magazine Grinders
The grinding floor is entirely free of wood, the logs being brought by conveyor to this overhead charging floor and stored at the sides, to be loaded into the magazines through the gates shown in the central aisle. The ventilating system removes steam that escapes when these gates are open

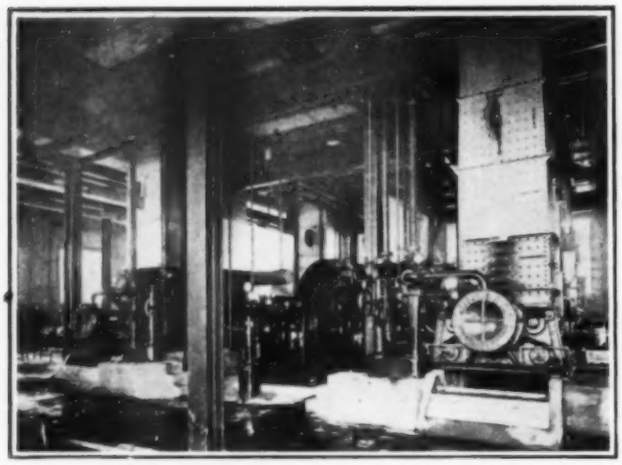


Fig. 10—Close-up of Two Magazine Grinders
These machines are driven from a common motor placed between them. A load regulator of the ammeter type is shown just in front of the motor

stone by endless chains. This development was interrupted by the war but has been completed in recent years.

In the final machine, the wood is held away from the magazine walls, to prevent jamming, between two chains which gradually compress it as it approaches the stone. The first two commercial machines, for 20- and 40-in. logs, commenced operation in November, 1922, and January, 1923, respectively. On being tested, these showed an advantage over older machines. Not only did the feed function uniformly with logs of normal shape or even of extreme size, but it proved equally adequate for split logs, square pieces and slabs, which cannot be handled in the other types of machines.

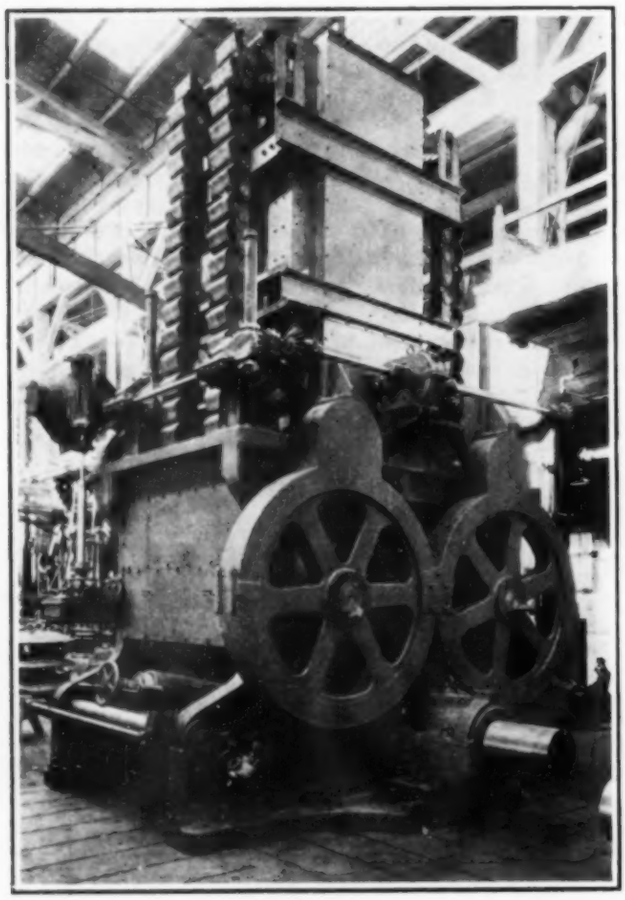


Fig. 11—Caterpillar Continuous Grinder
This view taken during assembly of the machine shows the chains and the chain drive and also the screw jacks, with their drive for lifting the magazine

At the present time two different types of feed chain are used on Voith grinders: the swinging link and the wedge link types. In operation each of these chains has a speed slightly superior to that of the wood column and a lateral compressing action is obtained by the swinging motion of the pressure arms or by the relative motion between the wedge links and the logs. The swinging link chain is preferred in Europe, while the wedge link chain is most used in America. This is largely due to differences in the wood ground.

The grinder shown in Fig. 11, and known as the "caterpillar" grinder has a stone 67 in. in diameter

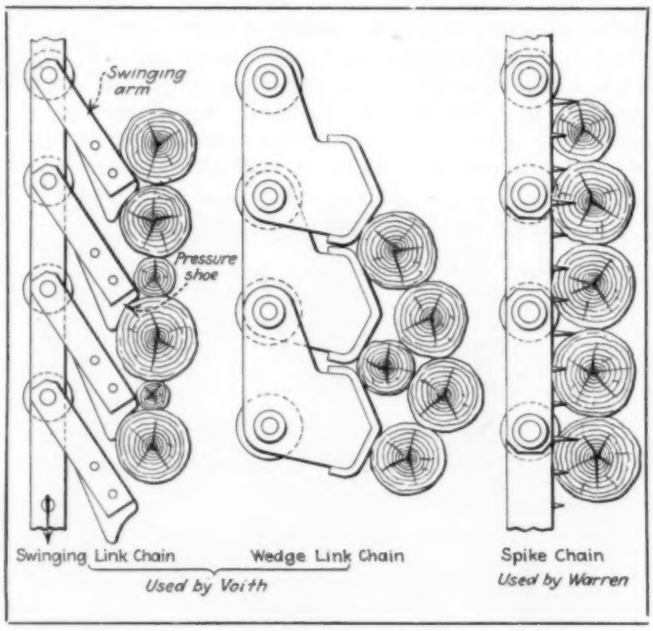


Fig. 12—Sketch of the Three Types of Chain Used on Continuous Grinders

with a 54 in. face. The magazine with its feed chains is central over this. The upper part of this magazine is of plate, angle and beam construction, while the base, forming the grinding pocket, is of heavy castings. The lowest part, which has a width of 40 in. is made up of two cast-steel finger plates, whose function is to hold back slivers until entirely ground off. The hopper and the pocket with these finger plates hang on the spindles of 4 screw jacks reposing on the main machine frame. By means of a small motor these jacks can be operated simultaneously to raise or lower the magazine for stone replacement or to compensate for wear of the stone. One of the lower side frames is divided in two pieces so that it can be easily removed. This shortens the time needed for changing the stone. In order to keep the stone always running true, a sharpening device, moved hydraulically, is arranged on the down running side of the stone. The machine can take up to 1,400 hp., and is built as an entirely enclosed unit so as to permit grinding at the highest temperatures without much escape of steam into the machine room.

The chains are driven by a hydraulic motor similar to a gear pump, fed with oil from 100 to 150 lb. per sq.in. pressure and running at from 250 to 300 r.p.m. Power is transmitted to the lower sprocket shaft of the

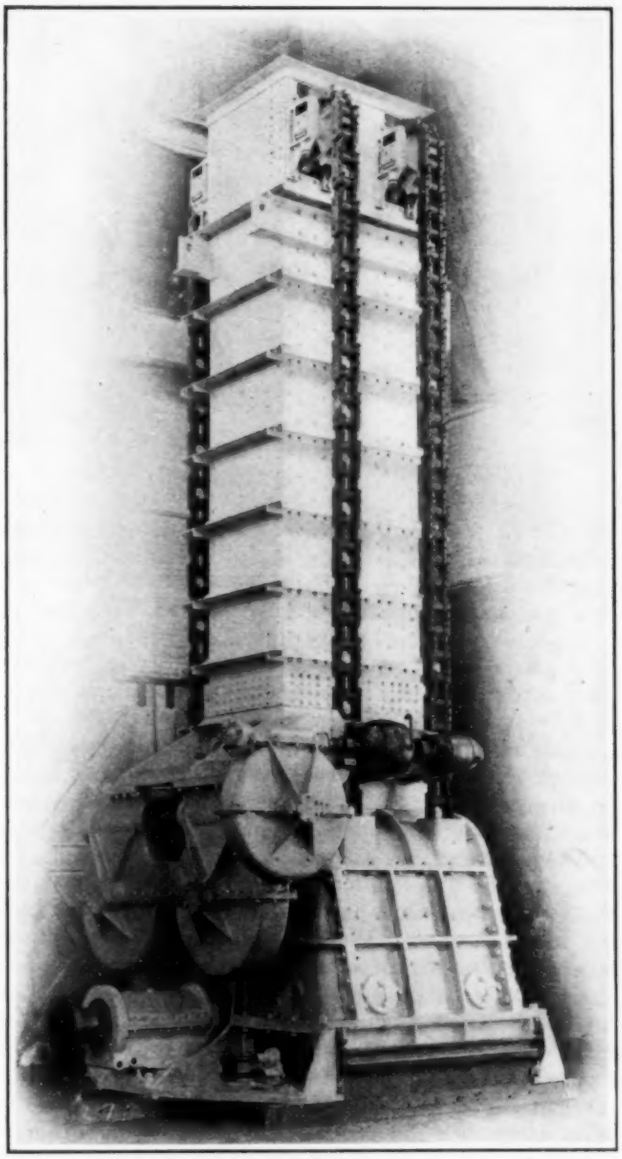


Fig. 13—The Warren Continuous Grinder
The spiked chains and feed drive show clearly in this view. The magazine is slightly tapered. All parts except the chain in its upward run are completely enclosed

feed chain by means of a vertical telescope shaft, double reduction worm gears and cast steel spur gears, the ratio of the entire drive being 9,000 to 1. The motor is stationary with the frame while the entire gear moves up and down with the hopper. This motor has a momentary torque 4 or 5 times normal, enabling it to overcome momentary high resistances caused by jams in the hopper. The use of fluid pressure for this motor permits the use of a common regulator for 2 grinders and distribution of the load on 2 machines in any desired proportion according to the diameters of the stones.

The pressure for these oil motors is produced by a pump of the gear or centrifugal type. Between the two is a throttle valve controlled by a governor. Any variation in the load of the machine varies the speed of the grinder shaft and therefore the speed of the governor. This regulates the throttle valve and hence the speed of the oil motor, which in turn regulates the speed of the feed. For electrically driven grinder chains, a governor of the Westinghouse or Waterous type can be used. In installations of more than one grinder, a common oil pumping plant is used, 2 grinders are driven from one prime mover and one regulator is used for each 2 machines. By regulating the main throttle valve through a pilot, the regulation is made extremely sensitive and accurate.

The Warren Grinder

Another continuous grinder has been developed by J. J. Warren. This also uses endless chains for feeding the wood against the stone. While in the Voith machine the chains feed the wood and also compress it, the Warren design uses the chains only for feeding, compression being obtained by tapering the magazine slightly. The chain is made up of links, each with three spurs of different lengths. On the forward end of the link just ahead of the pin is a long spur, following this is a spur of intermediate length and, at the center of the link is a short spur. This prevents the spurs from tearing the logs and so increasing the amount of slivers.

The main difference between the two types of grinder lies, however, in the drive of the feed chains and in the load regulation. The Warren grinder is built for electric drive and the feed drive and regulation are also electrical. The sprocket shafts are driven from a variable speed d.c. motor through one internal gear and two worm drivers, power being obtained from the exciter on the main synchronous motor shaft. A torque motor is connected through a current transformer to the main motor and its shaft is connected to the movable arm of a rheostat in the field of the small variable speed motor. This torque motor is balanced by a counterweight which is proportional to the load carried on

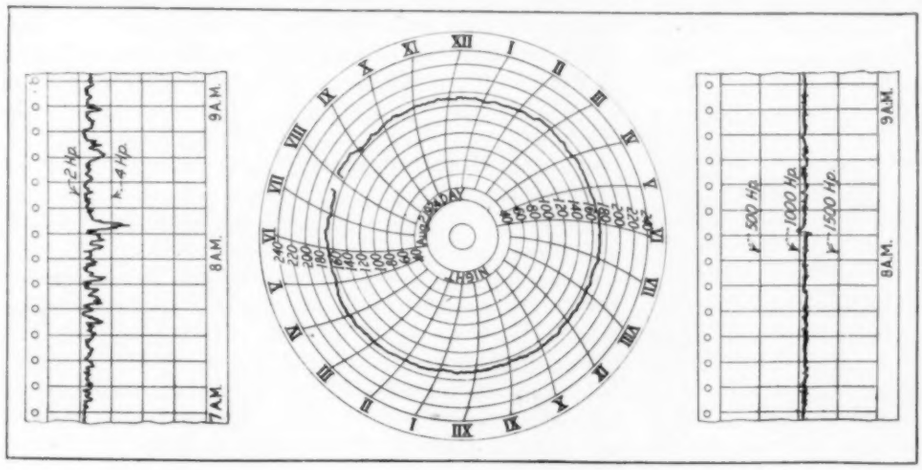


Fig. 14—Three Charts From Warren Grinder
These records show that the three important factors of load, pressure and stock temperature are kept closely regulated on the continuous grinder and explain why these machines are likely to be the choice for producing the uniform stock needed by modern high speed newsprint machines

the main motor. Should the load on the grinder drop, the torque on the induction motor is decreased and the counterweight will produce a rotation of its rotor. This moves the rheostat arm and speeds up the feed motor, hence increasing the load on the grinder and putting more load on the main synchronous motor. The result is a very even load on the grinder.

The high speed of present day newsprint machines demands ground wood pulps of definitely controlled quality. Therefore uniformity of stock is all important. With these new continuous grinders there is no doubt that a real approach to ideal grinding conditions has been made. It is thus highly probable that all future installations will be of the continuous type, which also saves in labor cost and makes a more efficient utilization of power. Two of the most recent ground wood mills, in Canada and in New Foundland, which will start production within a few months have already adopted the new machine. The first has installed 14 Voith caterpillar grinders and the second 18 Warren grinders. The results from these mills will be awaited with much interest.

Natural Gas as Industrial Fuel

The Place of This Valuable but Fast Dwindling Fuel Should Be Largely Confined to the Enrichment of Other Gaseous Fuels

By D. J. Demorest
Professor of Metallurgy, Ohio State University

OF ALL the fuels provided by nature, none is a greater convenience than natural gas has been to the communities that have been fortunate enough to have it. The chief drawback to this fuel is the limited amount that nature has stored and the resulting fact that those who have been using it are faced with the necessity of discarding equipment designed to burn it and obtaining other equipment when the supply runs out. Ohio, for instance, consumes three times as much natural gas as she produces, buying the rest from West Virginia. But the Geological Survey reports that West Virginia has only 25 per cent of her original supply left. It is evident, therefore, that any discussion of natural gas as a fuel should start with the recognition of the rapidly decreasing reserve supply and of the fact that the remainder of this supply should be used only where it can be most effectively applied.

Natural gas is made up almost exclusively of a mixture of paraffin hydrocarbons with impurities and diluents such as H_2S, CO_2 and N_2, sometimes present in mere traces and sometimes in large amounts. The natural gases of the Ohio, Pennsylvania and West Virginia fields have about the following composition:

Methane	85	per cent
Ethane	9	per cent
Propane	3	per cent
Butane	1	per cent
CO_2	0.2	per cent
N_2	1.8	per cent

The natural gas of Texas is high in nitrogen, carrying as high as 39 per cent nitrogen and the rare gases such as helium and argon. The heating value of the gas of the Eastern fields is around 1,050 B.t.u. per cu.ft. at engineering standard conditions, that of Texas about 700. Natural gas in this country does not contain free hydrogen, carbon monoxide or unsaturated hydrocarbons.

The reactions of combustion of natural gas in air are as follows:

$$CH_4 + 2\ (O_2 + 3.8N_2) = CO_2 + 2H_2O + 7.6\ N_2 + 1{,}008 \text{ B.t.u. per cu.-ft.}$$

$$C_2H_6 + 7/2\ (O_2 + 3.8N_2) = 2CO_2 + 3H_2O + 13.3N_2 + 1778 \text{ B.t.u. per cu.-ft.}$$

$$C_3H_8 + 5\ (O_2 + 3.8N_2) = 3CO_2 + 4H_2O + 19N_2 + 2513 \text{ B.t.u. per cu.-ft.}$$

From this it will be seen that 1 cu.ft. of natural gas of the composition common in the East requires about 10.6 cu.ft. of air and yields about 11.7 cu.ft. of products of combustion containing about 100 B.t.u. per cu.ft. gross, or 92 B.t.u. per cu.ft. net. When it is remembered that 1 cu.ft. of blue gas requires only 2.25 cu.ft. of air and produces 2.75 cu.ft. of products of combustion containing 110 B.t.u. gross or 102 B.t.u. net per cu.ft., it will be seen that a burner adapted for burning natural gas cannot be used with a gas like water gas. Also, although the amount of manufactured gas required to do a given amount of work will be greater than the amount of natural gas required, the efficiency in the use of the heat will be greater in the case of the manufactured gas, because each cubic foot of the products of combustion of manufactured gas has more heat to give up than in the case of natural gas.

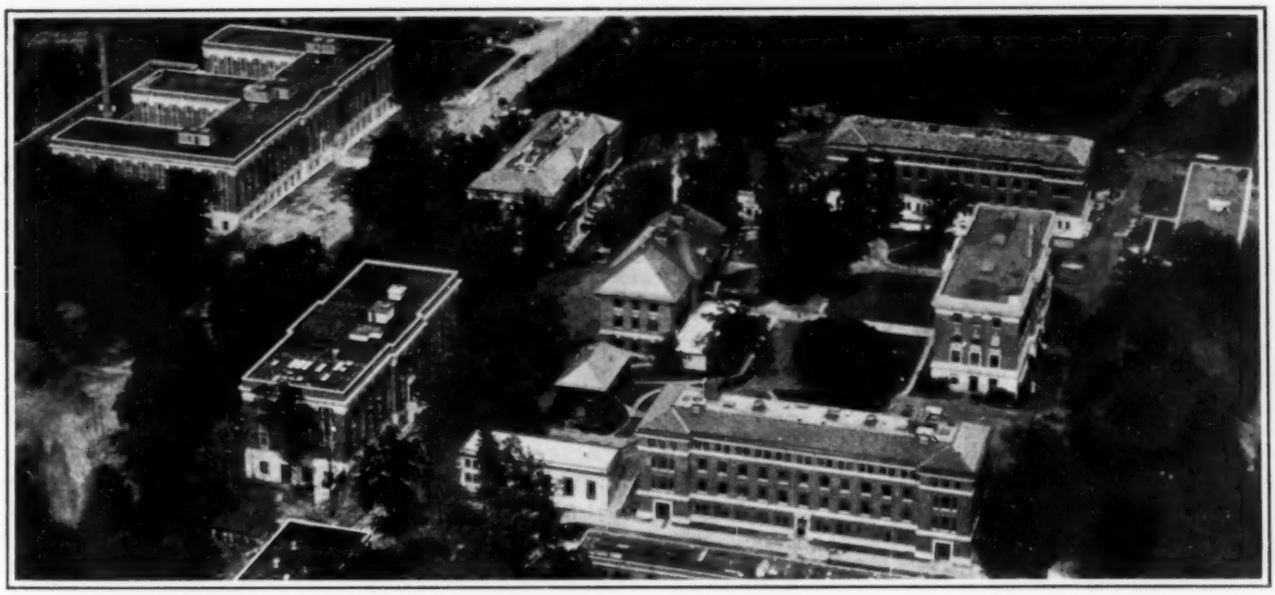
Since our stores of natural gas are being depleted so rapidly, it is obvious that it will not be long before no large city can rely on this fuel for its gas supply and supplementary supplies of manufactured gas must be provided. Already Kansas City, Cincinnati, Louisville, Toledo, Dayton, Cleveland, Columbus and many other cities that have had abundant supplies of natural gas in the past are either erecting or planning to erect plants for the manufacture of gas.

Manufactured gas for city use is commonly a mixture of coal gas and water gas, enriched to meet the local standards. Now, natural gas is the best enriching agent obtainable and whenever such action can be taken it should be retained for this use rather than for other purposes. To enrich 1,000 cu.ft. of a 400 B.t.u. mixed gas with oil gas to 535 B.t.u. will require 152 cu.ft. of 1,425 B.t.u. oil gas costing $0.14. To do the same enriching with natural gas costing $0.50 per thousand, requiring 262 cu.ft., would cost $0.13. Enriching with natural gas is easily carried out and makes a highly efficient use of it. Of course, the natural gas companies must make a profit on their investments and if the sale of natural gas for enrichment purposes does not bring in a sufficiently large income to yield this profit they must dispose of their product in other fields, but it would be fortunate for the country indeed if the remaining supply could be reserved for this use.

Standardizing Seger Cones

The work started by the Bureau of Standards some months ago on the standardization of Seger cones is making satisfactory progress.

A preliminary report on this subject was presented before the American Ceramic Society at the Columbus meeting on Feb. 18, 1925. The number of papers on the program prevented formal discussing of the report, but informal conversations with representative members of the society assured the Bureau of the interest and general approval of the methods followed.



Ceramics at the Bureau of Standards*

The First of a Series of Articles Summarizing the Investigations of the Ceramics Division During the Past Year

THE study of technical problems in the ceramic industry was inaugurated at the Bureau of Standards in July, 1910. At that time the ceramic work of the technologic branch of the United States Geological Survey was transferred by an act of Congress to the bureau. The investigations include the development of standards of quality, methods of test, and specifications for ceramic materials and products; the study of problems relating to the preparation and utilization of ceramic materials, and to the manufacture of ceramic products; the elimination of waste by supplying definite guides to purchasers, governmental and private, and by obtaining and disseminating to manufacturers scientific information of assistance in the improvement of products, and in increasing the efficiency of methods. The products embraced in this work include building materials, such as brick, hollow tile, wall tile and architectural terra cotta; drainage materials, such as sewer pipe and tile; paving materials, such as paving brick and floor tiles; refractory materials required for the lining of power, metallurgical and other furnaces; pottery and chemical porcelain; glass products, including window glass, glass containers and optical glass; and products made by the enameling of sheet iron or sheet steel, cast iron and other metals.

This is the first of a series of 5 articles reviewing the work of the ceramic division during the past year. Each article will be confined to a certain phase of the work as illustrated by the following topics: (1) pottery, (2) ceramic raw materials, (3) glass, (4) refractories, and (5) enamels and glazes.

Specifications for Vitrified (Porcelain) Tableware.—Insistent demands by the purchasing offices of several of the government departments led the bureau to undertake studies of vitrified tableware, especially of the heavier weights such as are used in restaurant and hotel service, which would lead to the development of specifications under which purchases of such ware might be made on a competitive basis other than appearance. This required a large number and variety of laboratory tests as well as attempts to correlate these results with actual service tests in hotels. The difficulty of obtaining satisfactory records in the latter tests led to their abandonment in hotels and their being undertaken in restaurants. However, what service tests were obtained from the hotels showed that American-made ware possessed a higher resistance to breakage than the imported ware. Sufficient data have been obtained to permit the establishment of a proposed master specification for vitrified chinaware for government use, which is now in the hands of the Federal Specifications Board.

The design in all cases must conform to the shapes adopted for government use, as shown in drawings accompanying the specifications. All ware must have a glazed foot. China of a grade known as "firsts" shall be free from bad warpings, and imperfections in the decoration. The average absorption of all ware of less than 10 in. maximum dimension shall not exceed 0.3 per cent (the absorption of no individual piece exceeding 0.5 per cent), and the average absorption of all ware having a maximum dimension of 10 in. or more shall not exceed 1.0 per cent. Satisfactory resistance to temperature change is determined by heating the article to a uniform temperature at 175 deg. C. and then plunging it into water which is at approximately 20 deg. C. This test may be conducted on any article indicated by the purchaser, and the samples should withstand at least 5 such quenchings without showing any crazing or cracking.

Impact tests shall be made only on 8, 7 and 5-in. plates, saucers, cups, platters and bakers. The ware

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Ceramics Laboratory at the Bureau

shall give at least certain average and minimum values in this test, depending upon the piece tested and its size. The average values range from 0.25 foot pounds for a cup to 0.45 foot pounds for a 14-in. oval platter. This specification covers material of 3 weights known as: thick china; hotel (or rolled edge) china; and medium weight china. The material and workmanship of the ware are defined and methods of test are described covering such qualifications as design, grade, limits of absorption, and resistance to chipping, impact, and temperature changes. Thick ware is defined as varying from $\frac{1}{16}$ to $\frac{3}{8}$ in. in thickness, and is the heavy type generally used for lunch counter service. Hotel weight (rolled edge) china is defined as varying in thickness from $\frac{3}{32}$ to $\frac{1}{4}$ in., and is characterized by a roll or bead under the outer edge. Medium weight china is defined as being somewhat lighter than rolled edge ware, the outer edge is not rolled or beaded, and it is the type generally used for restaurant and hotel service.

Chipping tests shall be made only on 8, 7 and 5-in. plates, and on saucers. The ware shall give at least certain average and minimum values in this test, depending again upon the piece tested and its size. The values range from 0.050 foot pounds for medium weight ware to 0.225 foot pounds for the heavy rolled edge ware. In making these tests a definite weight of a specified shape is allowed to fall as a pendulum through a specified angle against the edge of the plate and normal to it. If chipping does not occur the weight is allowed to fall through a greater angle. This angle is increased with each drop until chipping occurs. From the weight and the angle the foot pounds are calculated. In making the impact test, the same procedure is used except that the weight falls normally against the center of the back of the plate.

Factors Affecting the Crazing of Semi-Porcelain Dinner Ware.—This type of tableware differs from that just described by the difference in the degree of vitrification, and consequently its porosity, or ability to absorb liquids. This difference in the physical properties of these two wares is due largely to differences in the amounts of the various materials used, the vitrified ware containing, in general, more of the fluxing agents. The semi-porcelain, is readily distinguished from the vitrified porcelain by the translucency of the latter and the absence of this quality in the former, shows a tendency to craze in service. This fault is evidenced by the fine cracking of the glaze. An investigation in connection with the United States Potters Association has been under way for some time, studying the causes of this phenomena and methods of prevention.

Approximately 1,300 trial pieces, submitted by commercial concerns and representing 12 commercial bodies and glazes as well as the effects of variation in firing treatment and the thickness of the body and glaze applied, have been submitted to certain laboratory tests for the purpose of determining the effect of the variables mentioned. The following general statement can be made, based on the results obtained: (a) The amount of SiO_2 in a body did not seem to be a deciding factor in strengthening the body; (b) in some cases the transverse strength of the glazed specimens was greater than that of the corresponding bisque fired specimens, although in other cases the reverse was true; (c) susceptibility to crazing increased with thickness of glaze; (d) plates fired to cone 8 were most resistant to crazing; (e) susceptibility to crazing increased with thickness of body.

These conclusions when used in connection with previous data obtained in the petrographic examination of the body and glaze, and the determination of the coefficient of expansion of these, have led to some interesting but not definitely confirmed hypotheses of the cause and prevention of this undesirable property. Other work is being carried on.

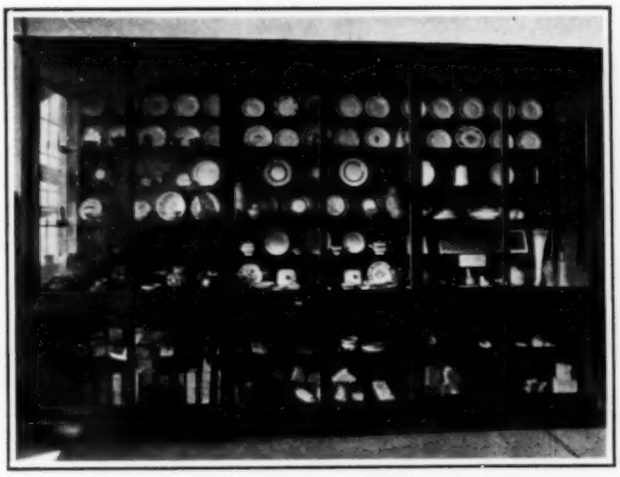
Thermocouple Protection Tubes in Glass Furnaces.—Work at this bureau and elsewhere has shown that the volatilized alkalies and batch dusts in the glass furnace atmosphere react with the aluminum silicates in refractory materials at high temperatures, producing crystals of corundum embedded in a sodium aluminum silicate glass. In the present study, petrographic examinations of thermocouple protection tubes have shown that the same action takes place in the outer part of

Equipment in the Pottery Room

American-Made Industrial Ware

thermocouple protection tubes which have been used in glass furnaces. On cooling, the outer altered shell cracks away from the inner shell, and the tube is weakened so that it fails. Apparently the failure is due to the difference in coefficient of expansion of the sodium aluminate silicate glass in the outer part of the tube and the unchanged aluminum silicates in the inner part.

Unglazed protection tubes have been made with high alumina and low silica content, so that only a very small amount of glass would be formed by the reaction with



American-Made Household Ware

the alkalies. When tested at the bureau, these tubes lasted twice as long as the ordinary ones, and some of them are now being tested in commercial glass plants. Efforts are being made to develop satisfactory glazes for these modified tubes.

Miscellaneous.—The ceramic division co-operates with the other divisions of the bureau in making special shapes and bodies that are not available commercially. Some of these are intricate in shape and require considerable special study in modeling, preparing of the plaster molds, drying and burning. In other cases, the requirements are such that it is necessary to develop a new body having definite properties such as low coefficient of expansion, impermeability and high melting point.

One dozen porcelain shapes were made for the electrical division to be used in the construction of an apparatus for the measurement of electrical resistivity. This work involved the preparation of 500 lb. of a new whiteware body, and the design of the special shapes. Six saggers of a body composition containing a high proportion of alumina were made for burning cement for the structural materials division. Two pot furnaces involving the casting, drying, and burning of several refractory shapes, were made for the metallurgical division. Approximately 175 small pots were cast of a refractory clay mixture to be used by the glass section in the melting of small experimental batches. There were also made for the glass section, 145 porcelain shapes of intricate design, for their use in the investigation of the viscosity of glass. Fourteen porcelain shapes of unusual refractoriness and intricate in design were made for the optics division to be used in the construction of apparatus for the measurement of thermal dilatations by the interferometer method.

Permeability Tests for Paper

In the valuation of many papers, their behavior in respect to penetration of liquids is of prime importance. A large number of the methods proposed for testing the permeability of paper to liquids are inadequate for the purpose, and the Bureau of Standards is endeavoring, through research, to improve existing methods and develop new methods.

The resistance of writing paper to ink must be such that the ink will not spread or penetrate through the sheet before it has had time to dry. Wrapping paper and paper bags are required to be sufficiently water resistant to prevent wetting through by damp articles, such as meat and certain other food products. Paper used to protect merchandise in transit or storage, particularly for overseas shipment and storage in damp climates, should be practically waterproof. In testing such papers a specimen is floated on water and on the upper surface is sprinkled a mixture of powdered sugar and a water-soluble dye. Any water which penetrates through the paper is immediately absorbed by the sugar, consequently the particles of dye scattered through the sugar develop their characteristic bright color, providing a definite end point. In this way it is possible to measure accurately the time required for water to penetrate through paper. Another method used for the same purpose consists in sealing the paper with paraffin to a glass cylinder, filling the cylinder with water and placing it on a piece of ground glass, which is made more transparent by the water that penetrates through the paper. This method of test is of particular value in connection with papers which are extremely resistant to penetration of water, such as various products waterproofed by the use of asphaltum.

At the other extreme from sized and waterproofed paper are absorbent papers such as blotting and toweling. These papers should readily absorb ink or water as the case may be. Their quality in this respect is found by noting the time required to absorb a very small but definitely measured amount of water placed upon the surface. Improvement in the technique of this method has made greater accuracy possible.

A special type of paper is used for wrapping greasy food products, and is required to be fairly resistant to animal and vegetable oils. This type of paper is tested by immersing a specimen in oil after sealing it to a glass cylinder with sirup or glue. The test consists in noting the time required for the oil to penetrate through, as judged by the appearance of transparent spots.

Factory Experimental Apparatus

Generally Accepted Practice Demands that a New Process Should at Least Go from the Laboratory to Unit Plant Stage

By Hermon C. Cooper
Glen Ellyn, Ill.

OPINION on this subject is not uniform. The difference starts in the engineering colleges. One school insists that if properties and reactions are studied thoroughly in the laboratory, a reaction can be transferred to the newly-designed plant in full confidence. Another believes that it is essential to study all the variables in actual factory-size machines before contracting for the final plant. There appear to be few factories, however, that do not conduct intermediate experimenting in some fashion.

An effort was made in a symposium at a recent meeting of the Chicago Section of the A.C.S. to ascertain current practice in regard to intermediate experimentation. The speakers were: A. J. Weith of the Bakelite Corporation, O. H. Wurster of Wurster & Sanger, E. P. Brown and R. E. Wilson of the Standard Oil Co. of Indiana, and the writer. The following generally accepted views were brought out:

The method of attack should vary with the complexity of the process and should be determined by a staff conference. The main factor influencing the decision is the expected return on the investment. Sometimes this is determined by a byproduct. Direct transfer is a hazardous undertaking, and is disliked by the ordinary chemical engineer. Risk is lessened by extending the period of preliminary study. If it were possible to anticipate every variable that will be involved, there would be little to fear, but the average engineer prefers to admit the possibility of overlooking something and likes to proceed cautiously. An example was cited where every variable in the extraction of a vegetable oil was supposed to be known, and a 3-ton extractor was ordered, but the operation worked differently on a large scale. A filer press should have been used to remove much of the oil. The difficulties of operating on a large scale are sometimes less than those encountered in the laboratory, but more often they are much greater.

Intermediate Plant Advisable

Except in the most elementary examples, the process should at least go from the laboratory to a unit plant, including the largest single piece of apparatus that is to be used. This plan has the merit of giving actual factory production at once, though not on the full ultimate scale. If standard equipment is employed, the unit plant will not cost much more than an intermediate plant and will make a strong appeal to the confident promoter. One of the largest equipment manufacturers maintains in Buffalo an experimental department equipped with standard units, where processes may be tried before ordering the desired pieces. A manufacturer of evaporators has installed machines in the University of Michigan laboratory, where optimum conditions can be determined and proper equipment selected. Reports indicate that before long every manufacturer of large equipment will maintain an experimental plant for the benefit of the customers.

In general, however, when the equipment is complicated and expensive, the building of a semi-factory scale plant is advised. Just how faithfully this should resemble the eventual installation is a disputed question. Some think it should duplicate the final plant in everything but capacity; others say that it need not necessarily look like the finished apparatus, that it may be more or less home-made.

The simplest method is to work in a large beaker of nickel, monel metal or hard rubber and to use the near-chemical apparatus designed for allied arts, such as baking or the making of pharmaceutical products. Color changes, corrosion and coatings can be determined by the use of large metallic beakers. A combination mixer and kneader is made by bakery-supply concerns and is provided with steam jacketed bowls of 4 to 20 quarts capacity. Small pharmaceutical machinery, such as mills and mixers, is readily obtainable and can be used in diverse mixing processes when no reaction is involved. A direct motor-driven agitator is made with clamp to fasten on the rim of a kettle and give high-speed stirring. A number of equipment companies, enameled iron manufacturers, for example, have small pieces capable of wide application. With the aid of a small countershaft with different sized pulleys the speed of agitation can be varied.

Tanks present no problem. If wood is unsuitable, a lining of lead or other metal can be put in or the whole can be made of concrete. Mills can be obtained in all sizes. The same is true of filter presses. Extractors and stills can be made in one size as well as in another. An oil refinery can be obtained in a 10 to 30 gal. size.

Foresight Results in Savings

One company spent $15,000 on a small-scale plant and found out that the process was not profitable, thus saving most of the $100,000, the estimated cost of the full-sized equipment. If a maximum of caution is desired, a combination of semi-factory scale equipment and unit plant should be employed, especially when profit is more important than speed, and competition is keen. When a well known oil refining process was being installed, the deposition of carbon was overlooked or over-estimated, even in the intermediate study; but the full-sized unit brought it out. The Standard Oil Co. of Indiana, in developing the Burton process had to prepare for more than a three-fold increase of pressure. They started with a 1-quart bomb and the stills were increased from 13 gal. to 50 gal. and then to a unit plant of 8,500 gal. costing $100,000. This was later multiplied into a battery according to requirements.

Welding can be used to great advantage in building relatively small apparatus for pressure and other work in oil refining. In the Whiting laboratory of the Standard Oil Company, it is as important as glass-blowing and is very serviceable, provided careful attention is given to the joints. Condenser coils in boxes, supports, hand-rails, walks, stacks and manifolds are constructed with comparative ease. The principal raw materials of construction are pipes of different sizes. The fabricators are ordinary factory welders.

So profitable was the interchange of experience on intermediate apparatus that there is a strong demand for a further and more detailed study of the subject.

Selecting Material Handling Methods For Economical Production

How the Dunlop Tire & Rubber Corp. Devised a Handling System That Gives Highly Satisfactory Results

By Graham L. Montgomery
Assistant Editor, Chem. & Met.

ANY industrial plant can be regarded, from one point of view, as a problem in material handling. The raw materials that are used in the processes of manufacture must first be brought into the plant. Then these materials must be put through various processes to make the finished products sought. These processes, chemical or mechanical, always involve some movement of the material. Finally the finished products must be packed, stored, and shipped; that is, moved out of the plant in a marketable form. This last step always requires handling of these goods.

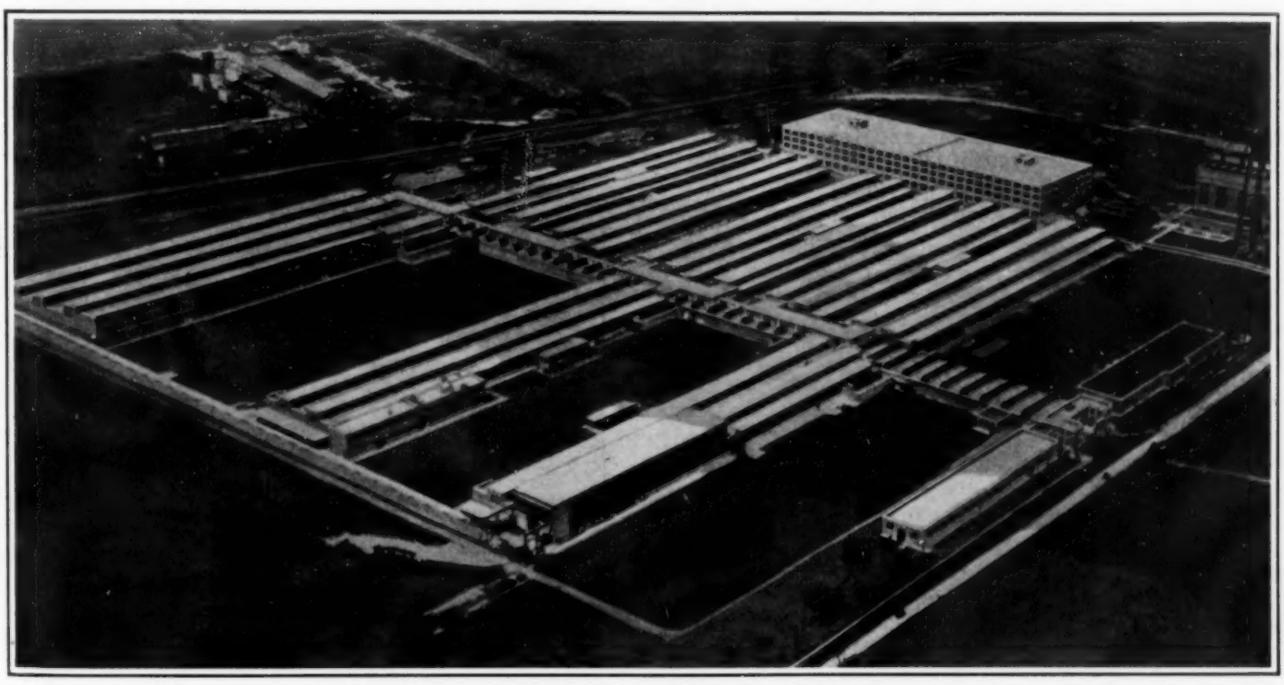
In an ideal plant, this series of movements would be continuous. Goods would move in a steady stream into the plant, through it and out again. Workers would then have only to see that machines functioned properly. The movement would be entirely mechanical and no human labor would be wasted in merely moving things about.

However, such a procedure is possible in only a few industries. In most cases, where the materials dealt with are not in liquid form throughout all the movement, it has so far proved impossible to organize a plant on a basis of continuous movement and still have it operate economically. Sufficient material handling equipment designs are available to make such organization possible in many places where it is not used. But, due to the difficulty of synchronizing succeeding processes, and even steps in a single process, and also on account of other factors that prevent a manufacturing plant from being organized as a continuous unit, it would often prove highly inefficient to install a continuous handling system.

There is, though, a nice balance that can be established which permits the fullest use of mechanical handling methods consistent with economical operation and hence the lowest attainable expenditure for handling material into, through and out of the plant. To reach this balance the problem must be studied from its very fundamentals. Preferably, such study should begin when the plant is first thought of, and should be carried straight through its construction into production work after it is in operation.

How Dunlop Solved This Problem

What this means can most easily be shown by recounting the methods used in a plant that has successfully attained this balance. Such a plant is that of the Dunlop Tire & Rubber Corporation, Buffalo, N. Y. This plant was built some 4 years ago by a company that already owned other plants in many parts of the world and had learned from experience the proper methods to follow in order to manufacture their product in an



Airplane View of Dunlop Tire & Rubber Corp., Buffalo, N. Y.

economical, efficient manner. Starting with the plant layout, shown diagrammatically by Fig. 1, the plant itself has been made a most effective part of the handling system used.

The plant is laid out on the two sides of a covered passageway 80 ft. wide and about one-quarter mile long. This passageway extends from north to south. On either side, with their long dimensions at right angles to the passageway, are the manufacturing buildings. Those on the west side are used for the receipt and preparation of raw materials and for the making of such appliances as molds and tools used in the plant.

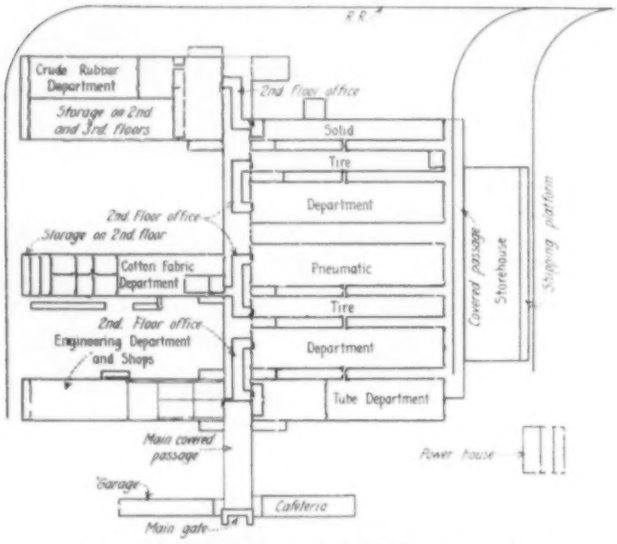


Fig. 1—Outline Plan of the Buffalo Plant of the Dunlop Tire & Rubber Corp.
This drawing shows the relations between the railroad spurs, the manufacturing buildings, the storehouse and the other elements of the plant

The railroad track layout for the receipt of materials and the shipment of finished products can be seen in Fig. 1. All goods are received at the west ends of the buildings on the west side of the main passageway. Shipping is done from the east side of the storage building, which as can be seen in Fig. 1, is east of the easterly ends of the manufacturing buildings, with its long dimension north and south. Thus, the manufacturing buildings feed, directly from their ends, into the side of the storage building and, across it, to the shipping platform.

Starting with the north groups of buildings on the west side of the passageway, crude rubber is received at their west ends and stored on the first floor, while pigments and chemicals, received at the same place in barrels are elevated to the third floor and there stored. The west ends of the buildings in this department and in the adjoining cotton fabric department are the only multi-story portions of the plant, except that the offices are located in a series of penthouses over the passageway. All other parts of the plant are of single story construction. Two advantages are gained from this: First, by the use of monitors and saw-toothed roofs, good overhead light is assured to all departments where there is any moving machinery; and, second, the handling system is simplified by the reduction of raising and lowering of goods to the minimum.

The rubber is received in bales, each bale in a wooden box, and is stored while still in this shape. The first step in the preparation consists in removing the rubber from the boxes and then cutting up the bales. After this, the rubber is milled and worked into sheets. The final step in its preparation is the milling into these sheets of a compound of pigment and chemicals, the exact composition of which depends on the rubber and the use to which it is to be put. This completes the preparation and the resulting sheets of refined rubber are ready to enter into the various processes of tire manufacture.

The handling methods used in this part of the plant are a fine example of how handling equipment should be selected to meet a manufacturing condition. It is impossible to synchronize the receipt of crude rubber with its use, which makes a discontinuous handling problem at the start. So these handling operations, i.e., unloading, storing, and distributing for use from car and storage the bales of crude rubber, are carried out by electric industrial trucks, which have in general proved the most economical means of performing discontinuous handling operations because their spare time can be utilized elsewhere for other handling operations.

Following through with the work of preparing and compounding the rubber, we find a series of operations that have not so far lent themselves to synchronous organization. So, again the handling is accomplished by electric trucks; this time lift trucks being used with the goods to be handled placed on skid carriers, each designed to fit the particular handling operation it is to accomplish.

Throughout this department there is but one operation that can use fixed conveyors to advantage. This is the gathering of the batches of pigment and chemicals for rubber compounding. These materials, stored on the third floor, are prepared on the second floor and are then placed in silos with hopper bottoms projecting down into the first story. Batch boxes are passed under these hoppers on a gravity roller conveyor and, after being charged with a weighed portion of each of the materials of the desired batch, pass through an inspection department, still on the conveyor. From this last point they are handled to the machines by a specially designed hand truck of the fork type, which can carry two boxes. This hand truck also serves to deliver the empty boxes to a booster conveyor of the push-bar type which carries them to the top of the run of gravity conveyor that passes under the hoppers.

Where an Overhead System Pays

The principal raw material of tires, next to rubber, is cotton, either in the form of duck for fabric tires

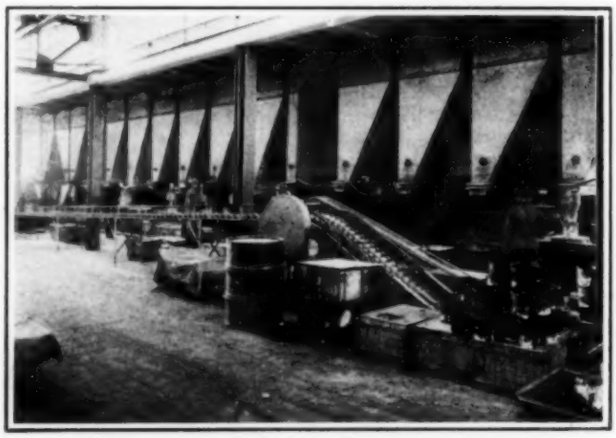


Fig. 2—Conveyor Used in Batch Collecting
The pigments and chemicals used in the compounding of the rubber are stored in overhead bins and, when wanted, are deposited in weighed amounts in the batch boxes on this conveyor

or as cord fabric for cord tires. This material is received at the west end of the cotton department, wound in rolls on wooden beams. It is rewound onto iron spindles which, interchangeably, fit the creels of the calenders and other machines used in preparing it by impregnating and coating with rubber.

Although the handling in this department is also discontinuous, though less so than in the crude rubber department, it differs in that the material handled is in the same form throughout the processing, that is, rolls wound on steel spindles. Because of this fact, and also because of the weight of the rolls (1,500 lb. each), their shape, and the fact that they must be raised from the floor to be placed in position in the creel, an overhead handling system of the trolley type is the most economical to employ. The system used is hand operated, having hoists of the triplex block type and ball-bearing trolleys that permit easy movement along the rail to the desired point. It is thought that the extra expense of an electrically operated monorail system would not be justified by the small saving in operating expense that it would give in this particular case.

After the cotton has been prepared, the rolls, still on the steel spindles, are stored on a system of steel racks, so that they are just above truck platform height. These racks are so designed that the rolls can be easily pushed along them by hand, the spindle ends rolling on the steel rails of which the rack is made. When one of these rolls is to be moved to the manufacturing de-

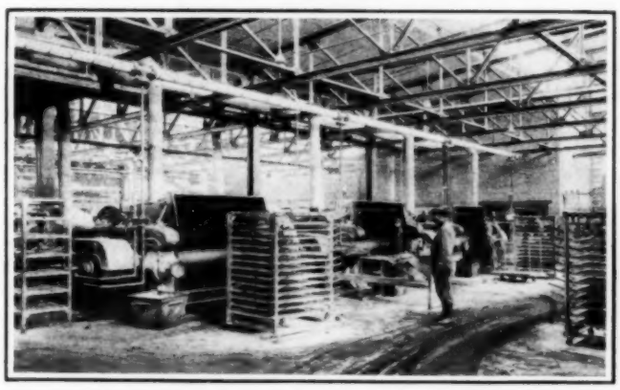


Fig. 3—View in Rubber Compounding Department
Some of the skids and trucks used in handling rubber sheets and also the batch boxes for chemicals and pigments are seen in this view

partments, it is rolled off the rack onto the platform of an electrical load truck and trucked to the point where it is needed.

Handling in Solid Tire Manufacture

Up to this point, only the preparation of materials has been considered. It has been shown how materials are received and conveyed through the preparation departments, until they reach the west side of the main passageway (see Fig. 1). The tire manufacturing departments are on the east side of this passageway, and materials are brought to them by electric truck.

For making solid tires these materials are, in the main, two: rubber for treads and steel rims. The rims are delivered at the receiving track and trucked to this department. Here they are first cleaned to remove any rust and are then hung on the hooks of an endless cable conveyor. They first pass through two coating processes, in which the face of the rim that receives the tread is coated and then to the point where they

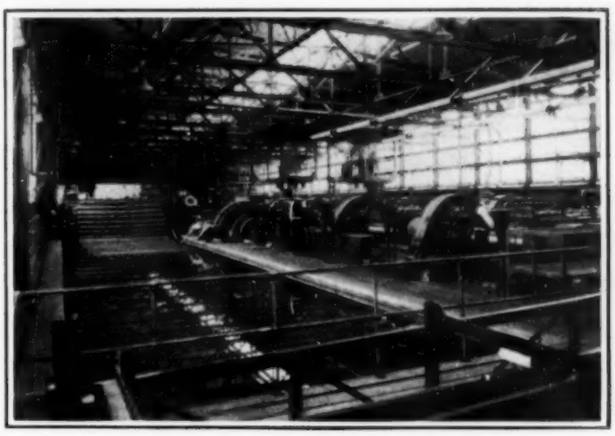


Fig. 4—Cooling Tank for Solid Tire Treads
This view shows the construction of the cooling tank and its conveyor and also gives a good idea of how thoroughly mechanized solid tire manufacture is

meet the treads. Between each of these points there is a sufficient run of conveyor to allow for drying.

The tread rubber is first worked to proper consistency and then fed by belt conveyor to an extruding machine, from which it emerges as a square bar, large enough to make 2 or more treads. This bar is fed out onto a roller conveyor and there cut to the proper lengths. The final section of this conveyor is situated across the end of a tank of water. It is so constructed that part of it can be swung to one side and the length of tread rubber permitted to drop into the tank. In this tank is a broad canvas belt conveyor that carries the treads through it under water and thus cools them. This same conveyor also raises the treads out of the tank and delivers them to a roller conveyor that is located at right angles. From this they are fed into a cutter which divides them into 2 equal pieces and then, turning them again through a right angle, delivers them to a gravity conveyor line extending longitudinally in the building. Passing along this conveyor, the tread enters a device which roughens its under side and it then receives 2 coatings of solution. It is then delivered to the point where it meets the rim. All this movement has been by conveyor.

The tread is now placed on the rim and the tire is then rolled along a chute to the point where the vulcanizers are located. Here handling is done by a specially designed rotary crane having two booms, one for

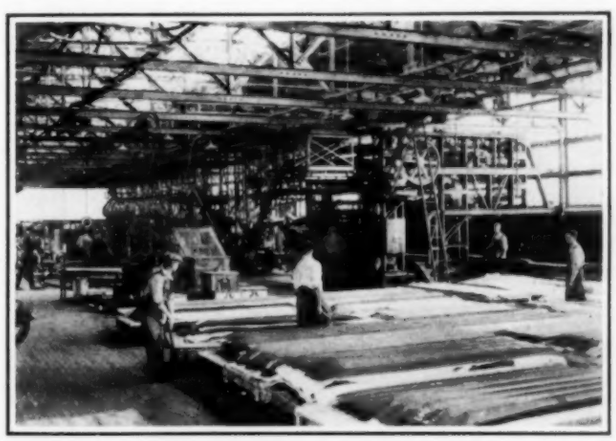


Fig. 5—Rim and Tread Conveyors
While there is a certain storage of treads as shown in the foreground, in normal practice the treads on the conveyor at the right and the rims on that at the left pass continuously through the coating machines to a point beyond, where they meet

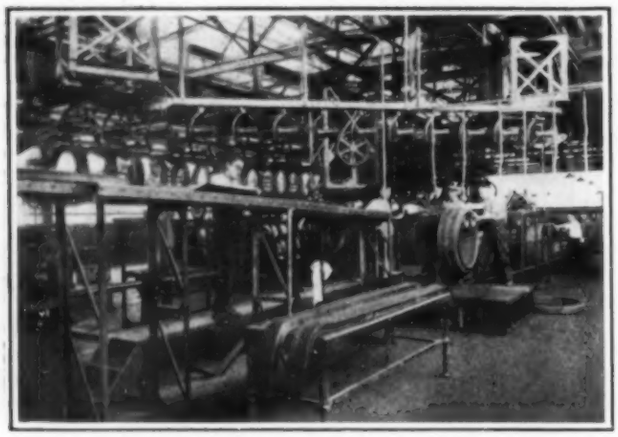


Fig. 6—Placing the Tread on the Rim
After the workers on the platform fix the tread properly in place, the tire is rolled down the chute which shows on the right to the department where it is vulcanized

handling the empty and full molds and the other for handling the tires. After curing in the vulcanizer, the finished tire is cleaned and inspected and passes by industrial truck to storage or shipment.

Pneumatic Tire Handling

Pneumatic tires are built up on a core and are composed of a varying number of layers of rubber and rubber impregnated fabric on the outside of which is a thick rubber tread. All these different parts of the tire are made up in that part of this department nearest to the passageway and then pass to the eastward to the tire building department. Handling to and between these operations is done by electric and hand lift trucks and skids, except in the manufacture of treads, where a system like that described for solid tire treads is used. The parts for the tire casing, ready to go to the builder, are arranged on a novel type of skid. This is built like a revolving display rack with leaves of galvanized iron, alternate leaves not reaching to the top of the rack. The various parts of the tire are hung over the short leaves, and being thus held apart by galvanized iron, are prevented from sticking together. Each of these racks contains a day's supply of materials for one tire builder.

As the casings are finished, they are hung on the pegs of wheeled trucks that are built something like pedestal hatracks. These trucks, when filled, are wheeled to the department in which the treads are put on. The tires are then hung on the hooks of an endless cable conveyor and pass to the vulcanizers for curing. Between each 2 vulcanizers is situated a pneumatic hoist, by means of which the molds are lifted out of one vulcanizer, emptied, refilled, closed and placed in the other vulcanizer. The cured tires are hung back on the hooks of the endless cable conveyor and pass to the trimming station, where they are taken off the conveyor, the fins trimmed off and the tire generally cleaned. They are then placed on a flat belt conveyor and pass through the inspection department. Accepted tires are replaced on this belt after inspection and pass to its end, where they are snubbed off onto a short run of gravity conveyor set at right angles to the belt.

Fig. 7—Making Parts for Pneumatics
The ordinary automobile tire casing is made up of many parts which are first constructed separately and then built up into the finished tire of commerce

This gravity conveyor delivers to the bottom of a flat belt booster conveyor. As the tires pass up this they are counted by an automatic device. At the top, which is also the eastern end of the tire manufacturing department, the booster delivers the tires to a gravity roller conveyor which takes them across the intervening space to the storehouse. Here they are first cleaned, then painted, then wrapped and finally made up into packages each containing several tires. These packages are then stored or loaded into cars or delivery trucks for shipment. The handling necessary in this storehouse is done by several types of factory trucks and skids, each suited to its particular duty.

Fig. 8—Tire Building Department
Tires are built over cores on specially designed machines. Note the special racks on metal skids, between the galvanized iron leaves of which the parts that go to make up the tire are stored

Handling in Tube Manufacture

The rubber for tubes is delivered from the crude rubber department by electric truck. It must first be refined. This is done by reworking in machines similar to those used in its first preparation—mills and calenders. The handling methods used are also similar, use being made of trucks and skids.

After the refining operation is completed, the rubber is fed by belt to extruding machines designed for the manufacture of hollow tubes. These tubes are extruded onto carriers and then moved by conveyor to a department where lengths are cut and prepared for vulcanizing. The tubes are then piled on the trays of a skid carrier and moved by truck to the curing department, where each one is placed on a mandril prior to being placed in the vulcanizer.

The mandrils used by this plant are of spiral form, having the same radius that the finished tubes are to have. This is so that the tubes, after curing, can be formed into hoop-shape without placing any tension

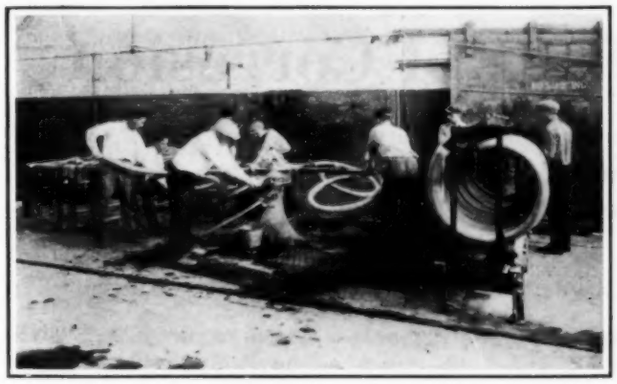


Fig. 9—Placing Tubes on Mandrils
A special capstan-like device has been designed to expedite this work. The man on the right of the machine removes a cured tube from the mandril after fastening mandril on capstan. The next man cleans the mandril. Next an uncured tube is placed on it. Finally the mandril with the uncured tube is removed and hung in the skid rack, from which a cured tube on a mandril is taken and fastened to the capstan.

on the outer circumference or compression on the inner, as would happen if they were cured straight. The work of placing the uncured tubes on the mandrils and removing the cured tubes has been combined in such a way as to eliminate most of the handling and make the operation quick, simple and efficient. The device employed is shown in Fig. 9, and its operation is there explained.

As the cured tubes are removed they are placed on trays on a belt conveyor that passes through the remainder of the tube shop to its east end. As the tubes pass along this conveyor, workers on either side of the belt perform such operations as joining the ends of the tubes, placing the air valves, etc. The tubes, finished, inspected and boxed, are delivered direct by conveyor to the storehouse for storage or shipping.

What This Layout Shows

The plant described in this article might almost, in the words of one of its engineers, be considered as "a handling system in itself." The use of single story buildings does away with all the useless and expensive elevating and lowering of materials so often met with. The proper choice of a plant site, the proper layout and design of the plant, and the use of foresight in planning the operations have eliminated much handling that would otherwise be necessary.

The plant layout at this Dunlop plant insures a straight line flow of materials into the plant, through it, and out again. Cross-currents in this flow, resulting in eddies and consequent stagnation, are not possible.

Fig. 10—View of Shipping Platform
This picture gives an idea of the methods used at the Dunlop plant for loading cars by trucks and skids

Everything has been done to aid manufacture that can be done by layout. Nothing, on the other hand, has been done to block manufacture or make it more costly than need be.

In providing means for moving material through the plant, account has been taken of the performance possible in the several departments. No attempt has been made to link together, by means of fixed mechanical conveyors, processes that are by their nature discontinuous or impossible to synchronize. Where, however, such conveyors can be used advantageously and with true economy, they are employed to the fullest extent. Elsewhere, such devices as electric or hand trucks, that are flexible and can be kept constantly in operation doing several different things, are employed. The handling system has been kept as simple as possible, needless complication, and the expense that it would entail, being avoided. The materials are handled easily, are where wanted when needed, and are moved with a minimum of confusion and expense.

Thus it can be seen that the balance between mechanical handling equipment and other means of moving materials, that was mentioned at the beginning of this article, can be attained if sufficient attention is given to the matter. And it is certain that, if this balance is attained, the industry that does so cannot fail to reap its reward in better labor conditions, better and more uniform products, and more economical and efficient operation.

Enameling Cast Iron

Enamels for bath tubs, stove parts, and other cast iron wares often blister during the firing process, causing loss to the manufacturer and increased cost of the perfect product to the consumer.

The Bureau of Standards, in co-operation with the American Ceramic Society, has undertaken a thorough study of cast iron for enameling purposes to determine the iron most suitable for this work, and, if possible, the cause of blistering of the enamel when fused onto castings made from certain types of pig iron. Two types of pig iron are being used in the cupola charge. A popular opinion among enamelers is that castings made from 100 per cent pig iron of these two types cause blistering of the enamel, although this condition is remedied somewhat by adding scrap castings to the melt. In each of the first two experimental runs of castings, 100 per cent of the above mentioned pig iron was employed.

Sample castings were enameled both in the laboratory and in the plants of various manufacturers. The enamels used are designated by the trade as the wet and dry process enamels. The wet process enamel is ground fine and suspended in water as a dip, using clay as the floating agent. This slip is sprayed onto the casting, dried and fused at comparatively high temperatures. The dry process enamel is also fused at these temperatures, but the casting is first heated and the dry enamel powder sifted on to give a smooth coat.

No conclusions have been drawn, since the investigation is not far enough advanced. Further work has been planned to include varying cupola charges from which castings are to be enameled, both in the laboratory and in commercial plants. Chemical, metallographic and spectroscopic analyses will be made of the castings before and after enameling in order to determine any changes which might take place.

The Causes and Effects of Corrosion

Digest of the Corrosion Symposium Given at the Baltimore Meeting of the American Chemical Society, April 8 to 10, 1925

By Robert J. McKay
Chairman, Corrosion Committee, American Chemical Society

THE Industrial Division of the American Chemical Society held a three-day symposium on corrosion at the meeting at Baltimore the week of April 6th. The Symposium was worked up by the Corrosion Committee of the American Chemical Society as a step in the study of the theory and mechanism of corrosion. Robert J. McKay, Chairman of the Corrosion Committee, acted as Chairman of the Symposium. Many of the best known men in chemical and metallurgical work in America delivered papers or entered into the discussion. The meeting was well attended and the interest shown in the discussion was lively.

The first session of the Symposium, held on Wednesday morning, was given over to general and theoretical matters. The introductory note by the chairman brought out the status of knowledge on corrosion, mentioning the lines along which recent progress has been made and along which progress may be expected in the near future.

W. M. Corse, Chairman of the Corrosion Committee of the National Research Council, followed with a description of the function of the Corrosion Committee of the American Chemical Society and its relation to the national organizations of corrosion committees. He summarized the high spots of progress during the last few years, while this organization has been in process of formation. The importance of the theoretical field allotted to the American Chemical Society was emphasized.

The next paper, by Wilder D. Bancroft, of Cornell University, critically described the theoretical points which have been brought out in the corrosion study of the last twenty-five years. These were discussed principally with reference to their bearing on electrolytic corrosion. The agreement of many of these points with experiments in the author's laboratory was pointed out. Dr. Bancroft thoroughly endorsed the electrolytic theory. He stressed the value of further research, particularly on the effect of oxygen supply to the corroding metal and of films, and on the development of a satisfactory accelerated test.

Frank N. Speller, of The National Tube Company, gave a thorough outline of the various factors which cause and affect the progress of corrosion and the mechanism by which they act. He also endorsed the electrochemical theory. His paper was a resumé and harmonizing of the opinions of all the prominent corrosion workers of the present day, resulting from a survey which he has made in preparation of a book on corrosion. It dealt most comprehensively with the corrosion of iron, but pointed out that modern research is penetrating so well into fundamentals of corrosion that the laws governing the corrosion of iron are shown to be substantially those for the corrosion of nonferrous alloys. He explained corrosion by an analogy with the flow of liquid in a system of pumps and valves, which is enlightening to engineers and others who are more interested in the practical effects of corrosion than the chemical minutiæ which are involved in the theory. This paper was perhaps the most fair and complete summary of the various opinions of the mechanism of the corrosion of iron that has yet been published. Apparently, principally due to the necessity of presenting these in a short space, and secondarily to incompatibilitiy of the opinions themselves, the paper was slightly disconnected in places, but this was outweighed by the mass of sound information contained.

George M. Enos, of the University of Cincinnati, had prepared a paper for this session which was received too late for the formal program and which, in Professor Enos' absence, was presented by Robert J. McKay. Professor Enos' paper brought out a rather new viewpoint in discussing the theory from electronic considerations, thus more or less belittling the several "theories," but endorsing the electrolytic theory as a natural progression toward the electronic conceptions by which all the phenomena of chemistry are now being explained. Mr. McKay agreed with Professor Enos in the idea that this electronic conception will satisfactorily explain all this phenomena without the aid of the other ideas which have been designated "theories of corrosion." The paper reported the results of experiments on the effect of four of the factors which might be expected to affect the rate of corrosion of steels exposed to atmosphere or immersed in various solutions. The chemical composition of the steel, as determined by its carbon content, was shown to be without material effect. Increase in temperature from ordinary room temperatures to the boiling point of water increased the corrosion rate in all cases. The corrosion rate was shown to change with the time of exposure and to depend on the nature of the corrosion product and other factors. Sometimes the rate will increase, and under other conditions it will decrease. Various types of light were shown to have a measurable effect, but this effect was small compared to that of other factors.

The last paper presented was by W. R. Whitney, Director of Research, General Electric Company. Dr. Whitney was the first author to present the application of the electrolytic theory to corrosion in a thorough and usable manner. During the years since his first presentation, in 1913, there has been no real contradiction of his views, although recent workers have added much to them. Thus, Dr. Whitney was credited with the first really valuable outline of corrosion theory. His paper described the progress of the corrosion of steel turbine blading by steam and water at high velocity, and the laboratory apparatus which was developed to duplicate the action and study it. The English

work attributing the action of water on ship propellers entirely to erosion was compared to his own laboratory tests and observations. Observations on copper and bronze wire towed through sea water during the war were quoted. In Dr. Whitney's experiments, the chemical effects were distinguished from the physical by allowing the water to act on the metal with oxygen present and with it absent. The results showed conclusively that most of the wearing away, formerly attributed to erosion, is really due to corrosion, during which the corrosion products are carried away physically.

The presentation of the papers was followed by a lively discussion in which Jerome Alexander, W. D. Bancroft, W. D. Bigelow, C. G. Fink, John Johnston, W. R. Whitney, B. D. Saklatwalla, W. G. Whitman, R. E. Wilson, and others took part either personally or by written communications.

Second Day's Session

The opening paper on Thursday, April 9th, was "Accelerated Corrosion Tests of Copper-Zinc Alloys by Salt Spray," by W. H. Bassett and H. A. Bedworth. This paper told of the work that has been done in the laboratory of the American Brass Co. on the corrosion of various metals by the conventional salt spray test. The results of this test were compared with the results of long time immersion tests in sea water. The conclusion was reached that this type of test gives useful results in forecasting the behavior of the alloys in question to corrosion by salt water. The apparatus was described in detail. Tests were made on a range of copper-zinc alloys from 100 per cent copper down to 60 per cent. Curves were shown graphing the corrosion of these alloys, both in the sea water and the salt spray test at different periods during their progress. These curves gave an interesting picture of the action of this corrosion and showed that the alloys containing between 70 per cent and 85 per cent copper are best adapted to resist salt water corrosion.

In "Corrosion of Glass Surfaces," by George W. Morey, the effect of the composition of glass on its resistance to corrosion was discussed, and it was pointed out that to this property may be ascribed the extensive use of glass as a container. The idea that glass is corroded at a definite rate, in spite of the fact that its composition is entirely different from the metals which are usually the subject of corrosion study, brought an interesting variation into the discussion. Mr. Morey's paper was complete and interesting, describing the various possible compositions of glass and the variation of its other properties, as well as of its resistance to corrosion with composition. The mechanism of the corrosion of glass by water involves a probable miscibility of glass with water and, in its later stages, the complete decomposition of the silicates. Increase in temperature very much increases the rate of these actions. The term "solubility" has no meaning in this connection, but the rate measured is the rate at which certain reactions take place.

W. G. Whitman and R. P. Russell presented a paper on the effect of oxygen and velocity in the acid corrosion of metals. In the Research Laboratory of Applied Chemistry, at Massachusetts Institute of Technology, where the work was done, the effect of these factors in corrosion has been intensively studied. Results have been of the greatest value in clearing up the mysteries which formerly surrounded the variations of results in corrosion tests. They have shown that variation of these two factors causes great difference in corrosion rate. The paper was divided into two parts: In the first part the effect of dissolved oxygen was studied; and in the second, the effect of velocity. Quantitative results were given for several of the common useful metals, as follows: mild steel, chromium steel, aluminum, lead, copper, nickel, monel metal, and tin in sulphuric acid, hydrochloric acid, nitric acid, acetic acid, and mixed (sulphuric and nitric) acid. The effect of oxygen in solution was shown to be different for different metals and different solutions. In some cases it made no difference whether or not dissolved oxygen was present, but in many cases the difference was great, the presence of oxygen causing corrosion at 100 to 200 times the rate that held in its absence. These results showed the necessity of knowing the amount of oxygen present and its effect in making a corrosion test or using apparatus in corrosive solutions. The effect of oxygen is usually to increase corrosion, but it may diminish it where films are formed or passivity induced. Its effect is not as marked in the presence of oxidizing acids as of non-oxidizing. The experiments on velocity were carried out on copper and steel in the acids mentioned. Velocity was shown to have a large effect in the many cases in which oxygen is an important factor in the corrosion and to have an effect in the removal of films in cases where these are formed. There is much variation in the effect of velocity under different conditions. The results given in this paper are the first data of a general nature showing corrosion rates with these important factors controlled and their value in pioneering in this field cannot be overestimated.

Corrosion in Oil Refineries

The next paper, by Robert E. Wilson and W. H. Bahlke, describes certain special corrosion problems of oil refining and methods of combating corrosion. Tests were made on a large number of alloys under the special corrosive conditions and conclusions drawn as to the utility of the alloys in these special conditions. It was shown that different alloys were the best for different conditions. The corrosion in the "fire and steam" distillation of crude oils was shown to be caused principally by the hydrolysis of magnesium chloride in the salt which is present, producing hydrochloric acid in the condensed water. Nickel-chromium or high chromium steels and some special bronzes were shown to be resistant to this corrosion. In coking distillation and in cracking stills, the most severe corrosion occurs in the parts of the apparatus above 600 deg. F., and is due to hydrogen sulphide and other sulphur compounds. Under these conditions, the stainless steels and aluminum and calorized iron were resistant.

A. C. Zimmerman described the experiments at McCook Field in eliminating the stoppage of airplane fuel lines by corrosion products from the aluminum parts of carburetors, fuel pumps and tanks. These experiments have been of use in the development of new casting alloys and of protective coatings. The silicon-aluminum alloys were found to be the most resistant to water corrosion, and a sodium silicate treatment gave the best results as a protective coating.

This treatment not only inhibits corrosion but also reduces the porosity of the casting, and is now used extensively by the Air Service for the protection of cast aluminum parts which are exposed to corrosive media.

Written and verbal discussion of these papers then followed, and was participated in by W. H. Bassett, J. I. Crabtree, C. G. Fink, A. E. Marshall, R. J. McKay, H. S. Rawdon, R. P. Russell, and others.

Third Day's Session

A paper by Ulick R. Evans, of Cambridge, England, was read on "Oxygen Distribution as a Factor in the Corrosion of Metals," opening the meeting on Friday. This paper was a detailed discussion at length of the corrosion of zinc and iron by electric currents set up by differential aëration. The formation of films during this type of corrosion was given close study, their thickness being estimated by their interference colors. Dr. Evans has made a number of very interesting and useful studies along this line and has shown that the position of corrosion on iron, whether it is localized in one area or pitted over the whole surface, or evenly distributed, is due to electric currents set up by difference in the distribution of dissolved oxygen. According to Dr. Evans, the oxygen acts by the formation of surface films, which tend to make the areas over which they form cathodic, thus protecting them from corrosion. Then all the corrosion is concentrated on the anodic areas, which are not covered by films. He also described the effect of whirling his test pieces on the formation of films.

Norman B. Pilling and Robert E. Bedworth presented a paper on "The Oxidation of Copper-Nickel Alloys at High Temperatures," which gave the effect on the rate of oxidation of the complete copper-nickel series. It was shown that adding copper to nickel, or nickel to copper, in small amounts changes the rate definitely along a continuous line. The change is gradual up to 30 per cent nickel in copper and up to 20 per cent copper in nickel. The mechanism of the reaction in these is practically the same as with the pure metals. At the points mentioned there is a distinct change in the mechanism of the reaction, which shows itself in a deviation of the rate from the quadratic parabola which governs for pure nickel and copper. In other words, in alloys with more than 30 per cent nickel and more than 20 per cent copper, some other factor than the diffusion of oxygen enters into the reaction, but in those with less than 30 per cent nickel and less than 20 per cent copper, the rate is governed by this diffusion.

Predicting From Tests

"The Practical Use of Laboratory Corrosion Tests," by W. E. Pratt and J. A. Parsons, of The Duriron Company, was an interesting statement of the possibilities and dangers in relying on laboratory tests. A table was given, showing the various factors which should be taken into account in reporting tests, with typical examples indicating that in practically no case are all the factors covered. The apparatus used by The Duriron Company in making tests was described in detail, and a series of typical results given showing (a) initial losses at higher rate than constant loss after 24 hours; (b) error in predicting life of apparatus based on accelerated tests; (c) the use of constant loss rate in approximating depth of corrosion or penetration in inches per year; (d) the establishment of a factor to interpret the short accelerated test to the results of the constant loss rate of corrosion. The conclusion was drawn that, with proper precautions, corrosion tests can be used to determine the effect of changes in the chemical composition and visible structure of a metal on its corrosion. The value of standardizing tests and of centralizing research for this purpose was emphasized.

The paper "The Corrosion of Iron in the Absence of Oxygen," by J. W. Shipley, I. R. McHaffie, and N. D. Clare, of the University of Manitoba, was indicative of the high class of work now being done on corrosion in Canada. These authors have, during the past few years, added much to the knowledge of the corrosion of iron. Their study has covered corrosion in soils and many other special conditions. They have been particularly concerned with the effect of oxygen, both in producing direct oxidation and in its electrolytic effect, and in the present paper turn their attention to corrosion in the absence of oxygen. They show that, when oxygen is not present, the rate of corrosion of iron is proportional to the hydrogen ion concentration down to *p*H of 9.4, and that below this corrosion ceases. If no oxygen is present, corrosion is accompanied by the evolution of hydrogen, but since the potential necessary for the oxidation of iron is a little less than that for the evolution of hydrogen, the latter will not be evolved when oxygen is present. The results of a series of tests of the corrosion of iron submerged in impervious clay were given and the corrosion found to be due to (a) the buffer action of the clay in conditions sufficiently acidic to evolve hydrogen, and to (b) the lowering of hydrogen overvoltage by the thin film of solution on finely sub-divided clay in contact with the metal. Under these conditions, the authors find that the location of pits is determined by the constituents of the iron, but, if oxygen is present, the migration of ferric hydroxide to cathodic areas perpetuates and enlarges them. If the non-corrodible constituents are sufficiently adhesive, as is the case in gray cast iron, graphitic softening, rather than pitting, is the result of corrosion. This paper showed a full appreciation of the various views on electrolytic action and its conclusions were drawn with full cognizance of these different views.

F. E. Woodward presented a paper on "The Effect of Rust Preventive Compounds on Polished Surfaces." This paper did not go into the effect of coatings in preventing corrosion by the atmosphere, but rather the distinctive effect of rust-preventive compounds themselves. Tests had been made with and without exposure to weather, and with and without air. Microphotographs were given of the protected surfaces before and after testing. Mr. Woodward drew some interesting conclusions as to the properties which a protective grease should have, the principal ones being that its acidity should be low and its chemical composition should not be complicated. It should form a thin film, which will not "slip" at 100 deg. F.

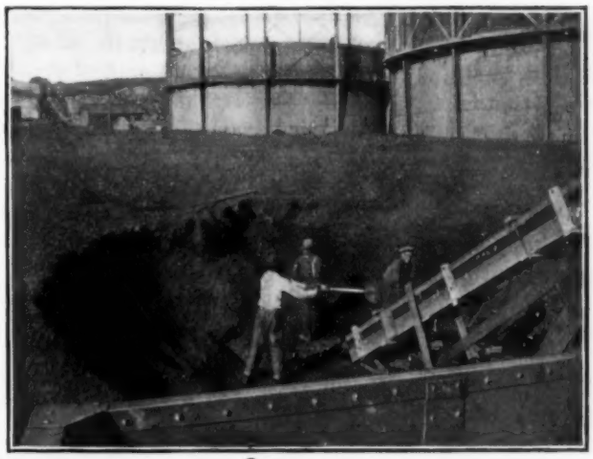
A discussion of these papers then took place, in which the following took part: R. J. Anderson, W. S. Calcott, R. T. Haslam, R. J. McKay, F. N. Speller, W. G. Whitman, and others.

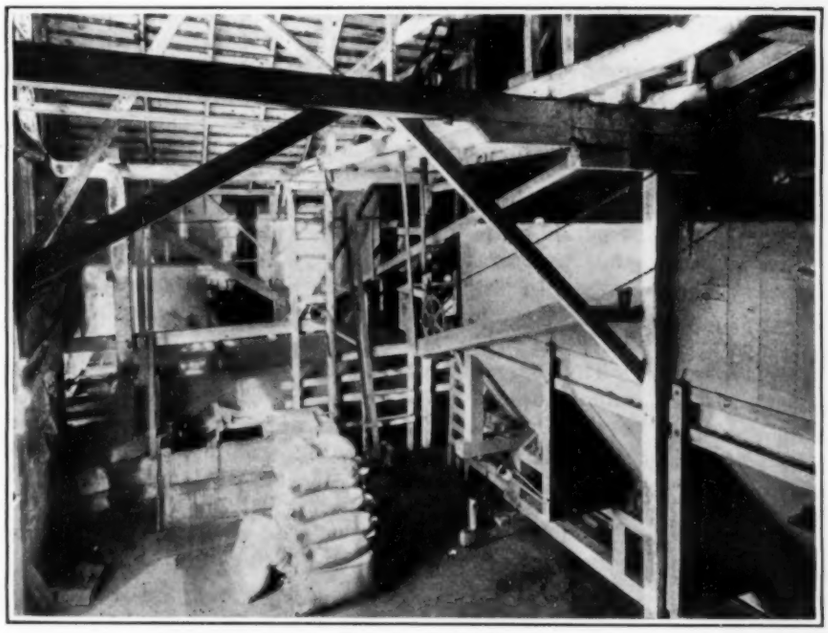
Waste Products Engineering

Competition Among Fruit Canners of California Has Created Profitable Outlet for Discarded Fruit Pits

By A. W. Allen
Assistant Editor, *Chem. & Met.*

THE utilization of the kernels of apricot pits is a history in itself. For many years prior to the war, the pits were cracked at the plants of some of the dried-fruit companies in California and the kernels were shipped to Europe. In 1913 a company was formed near San Jose, Calif., by persons connected with the fruit industry. "Why," they reasoned, "should these kernels go to Europe and the finished oil and other products be shipped back to the United States for sale?" Over $100,000 was spent by this company in development and in an endeavor to make saleable products such as sweet oil and kernel meal. An odd circumstance was the cause of its downfall. There was no market for nor any listing of apricot kernel oil in the United States! It had been marketed as peach kernel oil, all of which came from Europe; but this in reality was apricot kernel oil, as proved by test. The apricot kernel oil being manufactured in the United States came under the federal and state food laws, and could not be sold as peach kernel oil; therefore, there was no market for the domestic product, although an unrestricted one existed for the imported product! Another barrier against the sale of this new commodity was the absence of a railroad rate; it could only be shipped as a first-class commodity, at a high cost. Several years elapsed before a rate could be established. With a combination of two such barriers, the venture was a failure. A new company, The California Nut Products Co. was organized in 1914 with a factory at West Berkeley. After considerable research with apricot kernels, processes were developed for the manufacture of products such as sweet

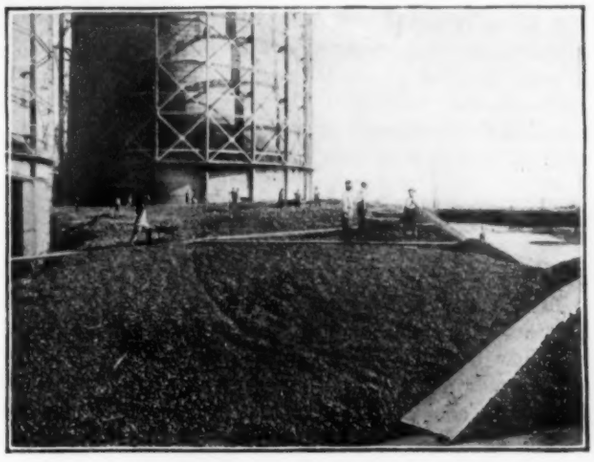




REMOVING PITS FROM STORAGE—*After fermentation of the kernels begins, the production of good oil is inhibited. The pit shells, however, can be made into a high-grade of charcoal.*

PLANT OF THE PACIFIC BY-PRODUCTS CO.—*The cracking rolls to the right separate the shells from the kernels; the mixed shell fragments and kernels are separated by flotation in a tank of brine. The floated kernels pass the steam-heated cylindrical driers seen in the distance.*

PART ON AN 8,000-TON PILE—*The California fruit industries discard about* 30,000 *tons of peach and apricot pits annually. Salvaging this waste is a matter of importance to the industry.*



oil, essential oil of bitter almonds and a macaroon or baker's paste.

The pits must be cracked before the kernels can be extracted, thus separating the shell now used in the manufacture of a high-grade charcoal. The cracking process is carried on in a plant where one is struck with the fact that mechanization of the process follows similar lines to that adopted in standard ore- and rock-crushing mills: Revolving trommels and rolls, flotation, shaking tables, cleaning and belt picking. The pits are delivered to a bin, from which they are removed by feeder, going to a revolving punched-plate screen, 20 ft. long by 5 ft. diameter, with apertures of various sizes. The pits drop into five different sets of crushing rolls that are adjusted so that the pits are broken, but with a minimum of damage to the kernels.

Kernels Separated by Flotation

The combined product from the rolls then passes to a trough in which a fixed level of brine is maintained with a specific gravity that insures the flotation of the kernels and the sinking of the shells. The latter are removed from one end of the trough by means of a scoop conveyor. To assist separation, the surface of the brine is agitated with beaters, which deflect the floating kernels to the other end of the trough, from which they are conveyed to steam-heated cylinders for drying.

Research by the Chemical Warfare Service during the war proved that nut-shell charcoal was the best material for use in gas masks, and the government thereupon commandeered almost all the fruit pits and shells available in the United States, as well as the coconut shells in other parts of the world to which it had access. Two plants, one at Astoria, L. I., and another at San Francisco, were erected for the charring of the pits. At the time of the Armistice, in 1918, the government had in San Francisco about 8,000 tons of peach pits on hand in one pile! This constituted a "white elephant," the cost of manufacture into charcoal being prohibitive from the peacetime industrial standpoint. The pits were bought by Stanley Hiller and his associates, the idea being to crack them and extract the oil from the kernels. From 8,000 tons of pits there would have been about 800 tons of kernels, which, at $200 per ton, the market price at that time, would have netted $160,000. It was calculated that total expenditures would not exceed $60,000, leaving a profit of $100,000. But, unfortunately, there were enough bad and fermented kernels in the pile to inhibit the production of good oil. The pits could not be sold as fuel, and their removal and dumping as waste constituted a problem, as they covered a city block 15 ft. deep. So it was decided to turn the pits into charcoal, but in view of the fact that the market for charcoal had decreased enormously it was necessary to evolve a new process and to find new uses for the product.

Heat Recovery Practiced

This was done successfully, and the Pacific By-Products Co., at San Jose, in the center of the fruit industry, is now operating under the Hiller patents and handles the majority of California's fruit-pit shells. During the past four years it has produced many million pounds of a high-class charcoal. The plant is not only a commercial success, but is an example of the ingenious application of well-known engineering principles; it is equally suitable for the carbonization of coconut or other shells.

The raw material is delivered to storage piles, under which conveyors take the daily supply to bins above the charcoal kilns. The pits are delivered by a feeding mechanism that regulates the flow of material into the upper end of the revolving kiln. A fire is lighted, and after the kiln is heated initially, the proper temperature is maintained by the combustion of the oncoming pits, which pass through the flame area and are discharged at the end of the kiln as charcoal. The operation of the process involves the automatic control of oxygen supply. The burning gas heats the lining of the kiln, which in turn distills the volatile material from the pits. The discharge charcoal is sprayed with water to quench and to cool it, is passed through air separators to remove small rocks and glass and over a magnetic separator to remove metal. The dust, about 200-mesh, is removed by a collecting system. After screening, the charcoal is put through a continuous cooling process, and is bagged, weighed and trucked to the warehouse. The product is sold for chicken, cattle and hog feed and for general industrial purposes. Steps are being taken to extend its use for fine chemical work, and considerable success has been reported as a result of its application as an adsorbent in the manufacture of rubber goods; also in the case hardening of steel. Further applications are developing in consequence of research.

The surplus gases from the kiln, passing countercurrent to the flow of material, go to the combustion chamber of a boiler, where they are mixed with the requisite amount of air and burned. Thus, steam is a byproduct from a byproduct plant! This goes to the cannery of the California Packing Corp., alongside, from which the "Del Monte" brands of fruit and vegetables are shipped, sufficient steam being provided thus to operate the entire plant, which is one of the largest in California, packing about 10,000 cases daily. When the charcoal plant is working to capacity, about 1,500 hp. in steam is developed.

The charcoal plant usually employs five men, who can handle over 100 tons of fruit-pit shell per day with ease. Duties include supervision of the two kilns and the boilers, and the grinding, grading, sacking, warehousing and shipping of the charcoal produced. The plant was designed by Stanley Hiller, with the assistance of Louis A. Clarke, who is now in charge of the operations of the Pacific By-Products Co.

Corrosive Action of Soils

Panoramic pictures have been made of the specimens of pipes removed from the ground in 1924 in the course of the Bureau of Standards soil corrosion investigation. These pictures, which are 6 inches wide and as long as the circumference of the pipe, show quite clearly the size and distribution of the pits, and where supplemented by the available data on the individual corrosion losses, are very helpful in the study of the effects of the soil on pipe materials. Individual pictures or complete sets of prints may be purchased by those desiring them.

Copies of the progress report on the soil corrosion investigation may be purchased from the American Foundrymen's Association, 140 So. Dearborn St., Chicago, Ill., at 30 cents per copy.

The Cooling and Conditioning of Air

Development of a Method of Calculating The Refrigeration Required by An Air Conditioning System of the Spray Type

By H. J. Macintire
Associate Professor of Refrigeration, University of Illinois

IN COOLING air it is possible to use a bunker room through which air is forced and brought into contact with refrigerated pipes, but this method is poor because heavy frost accumulation on the pipes lowers the efficiency of heat transfer. The more usual method at present is to cool by the use of a spray chamber, using a water spray in the case of temperatures above 33 or 34 deg. F., and water and brine sprays in two stages in cases of temperatures below 32 deg. F. When water is used, it is usually cooled by a Baudalot cooler in which the refrigerant boils on the inside of the pipes and water trickles over the outside from the top pipe down to the lowest pipe by gravity. The air is circulated through a chamber where it comes into intimate contact with water which is atomized by passing through a nozzle.

Fig. 2 (Willis Carrier, *Trans.*, A.S.M.E., 1911) represents a chart used for solving problems in air cooling. In this diagram it will be noticed that such a point as (*A*) represents a condition of 65 deg. F. dry bulb temperature and 60 per cent relative humidity. Lines sloping downward to the right are lines of constant wet bulb temperature and (*C*) is the temperature (56.7 deg. F.) of the wet bulb and (*B*) is the dew point temperature (50.7 deg.). The moisture content (*A*) is 55 grains per lb. dry air as is that of every other point on a horizontal line drawn through (*A*). In the chart the total heat measured from 0 deg. F. is given by the curve *FGH*.

It has been found by experiment that the heat removed in cooling air can be obtained by getting the difference of the total heats corresponding to the wet bulb temperatures at the beginning and the final condition. For example, if air is to be cooled from a condition of 65 deg. F. dry bulb and 60 per cent relative humidity (point *A*) to the dew point temperature (point *B*), the total heats are obtained from (*G*) and (*H*) as shown and these are 24.1 B.t.u. and 20.75 B.t.u. respectively. The volume of a pound of dry air with various

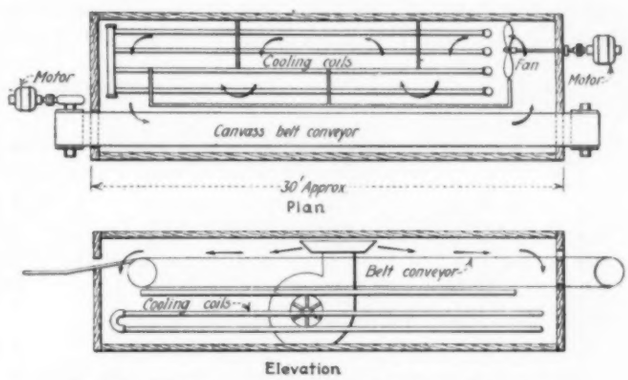


Fig. 1—Sketches of 2 Types of Cooling Chambers
Products to be chilled, such as glue, photographic films, or gelatine capsules can be conveniently handled in a chamber like one of those here shown, air cooled by a refrigerant circulated in coils forming the cooling medium

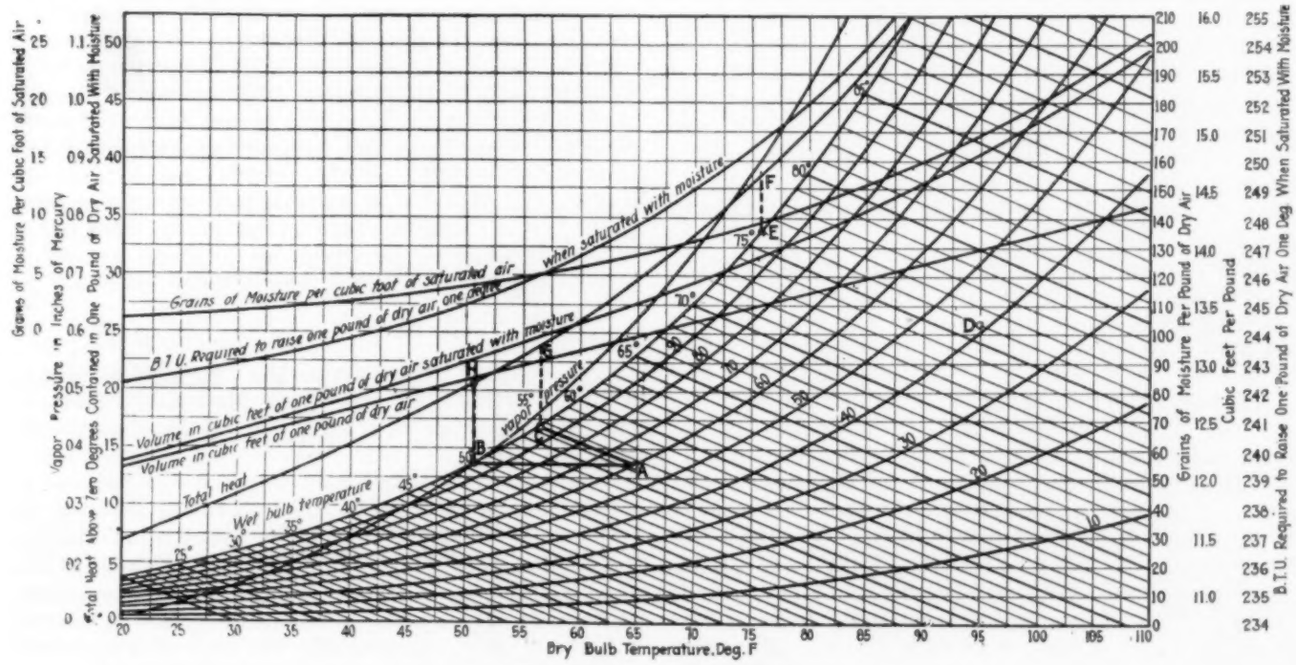

Grains of Moisture Per Cubic Foot of Saturated Air
Vapor Pressure in Inches of Mercury
Total Heat Above Zero Degrees Contained in One Pound of Dry Air Saturated With Moisture
Grains of Moisture per cubic foot of saturated air
when saturated with moisture
B.T.U. Required to raise one pound of dry air one degree
Volume in cubic feet of one pound of dry air saturated with moisture
Volume in cubic feet of one pound of dry air
Total heat
Wet bulb temperature
Vapor pressure
Dry Bulb Temperature, Deg. F
Grains of Moisture Per Pound of Dry Air
Cubic Feet Per Pound
B.T.U. Required to Raise One Pound of Dry Air One Deg When Saturated With Moisture

Fig. 2—Psychrometric Chart
This type of chart is of great value in solving problems of air conditioning or cooling by air

moisture contents can be found by referring to the two volume curves on Fig. 2; for example at 51 deg. F. the volume of one pound of dry air is 12.87 cu.ft. and when saturated with moisture it is 13.03 cu.ft.

With the foregoing it is possible to proceed with an illustrative example, one which is general enough so that the method of attack may be used in other problems if the details of the particular job are known. In calculating the refrigeration required it is generally necessary to make allowance for all sources of heat, i.e., the heat equivalent of the work performed, the heating effect of the electrical losses (I^2r), all process heating, heat equivalent of illumination, animal heat, heat of chemical reactions, etc.

Suppose a room in an industrial plant is to be maintained at a temperature of 65 deg. F. and 60 per cent relative humidity (Fig. 3). Its cubical contents is 204,300 cu.ft. and it has 1,248 sq.ft. of glass and 908

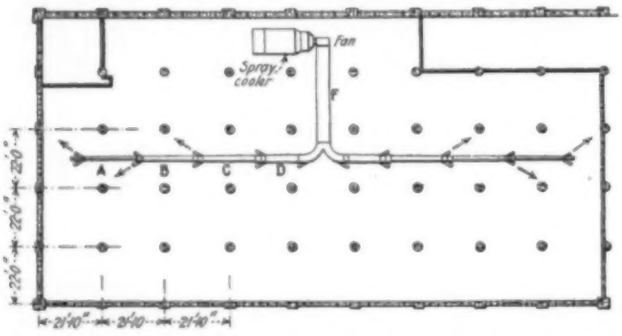


Fig. 3—Layout of Room With Cooling System of Spray Chamber, Fan, and Air Duct

sq.ft. of wall surface exposed to the sun's rays, and 2,154 sq.ft. of glass, 1,863 sq.ft. of wall, 2,728 sq.ft. of partition and 12,770 sq.ft. of floor area subject to heat leakage. The outside temperature of the air is taken as 95 deg. F. maximum with a wet bulb temperature of 76 deg. F. The infiltration loss is assumed as a complete change of the air in the room in five hours. The maximum number of operators is taken as 500 persons at any one time, and the illumination as 39-250 watt lamps. Let us find the total refrigeration, the size of the fan required to circulate the air and the amount of water to be pumped through the sprays, if the water is to be heated by the air from 43 to 51 deg. F., also the number of sprays, the amount of baffle and eliminator surface and the size of the ducts to convey the cooled air to the different parts of the room.

Referring to Fig. 2, point (A) is found at the intersection of the 60 per cent humidity line and the dry bulb temperature of 65 deg. F. The line (AB) is drawn so as to show the process of heating or cooling at a constant water content in the air, in this case a constant weight of 55 grains of water per pound of dry air. Point (B) means that the dew point required from the conditions of the problem must be 50.7 deg. F. and the wet bulb temperature (point C) must be 56.7 deg. If the air passed through the spray chamber is to have the sensible heat only removed from it so that the moisture content will always remain at 55 grains, then the air must be cooled down to 50.7 deg. F. and enough air must be circulated so that the total heat added to the room from all possible sources and tending to raise the air temperature must be removed by the sprays.

The heat absorbed due to the effect of the direct sun's rays is:

1,248 sq.ft. of glass at 0.5 B.t.u. per sq.ft. (per minute) = 624 B.t.u. per min.

908 sq.ft. of wall at 0.1 B.t.u. per sq.ft. (per minute) = 91 B.t.u. per min.

These values of 0.5 and 0.1 are practical experimental values to account for the effect of the radiant heat of the sun's rays.

People

500×5.0 (per minute) = 2,500 B.t.u.

The value 5.0 is the sensible heat given off by each workman per minute. This and the other values in the calculation of the amount of air to be circulated by the fan are the heat units tending to raise the temperature of the air.

Heat leakage (by conduction).

Glass

2,152 sq. ft $\times$ 0.46 (coef. of heat transfer per hour) $\times$ (95 — 65) = 29,700 B.t.u.

Wall

1,863 sq.ft. $\times$ 0.075 (coef. of heat transfer per hour) $\times$ (95 — 65) = 4,200 B.t.u.

Partition

2,728 sq.ft. $\times$ 0.09 (coef. of heat transfer per hour) $\times$ (95 — 65) = 7,370 B.t.u.

Floor

12,770 sq.ft. $\times$ 0.08 (coef. of heat transfer per hour) $\times$ (95 — 65) = 30,700 B.t.u.

Total heat conduction per hour = 71,970 B.t.u.
Total heat conduction per minute = 1,200 B.t.u.

Infiltration

$$\frac{204{,}300 \text{ cu.ft.} \times 0.246 \times (95 - 65)}{60 \times 5 \times 13.5} = 373 \text{ B.t.u. per min.}$$

Illumination

$$\frac{39 \times 250 \times 42.4}{746} = 556 \text{ B.t.u. per min.}$$

Total sensible heat per minute = 5,344 B.t.u. per min.
Add 5 per cent for contingencies = 267 B.t.u. per min.
Add estimated heat effect of fan (6.4 h.p.) = 272 B.t.u. per min.

Total = 5,883 B.t.u. per min.

This amount (5,883 B.t.u. per minute) is the total sensible heat entering the room, that is, it is the total heat entering per minute tending to raise the temperature of the air in the room. As the refrigeration is to be accomplished by the use of water sprays in a spray chamber it is necessary to move enough air through this chamber so that heat will be absorbed by the water at the rate of 5,883 B.t.u. per minute. This air so circulated leaves the room at 65 deg. F. and enters it again from the sprays at 50.7 deg. F. In other words, there is a rise of temperature of 14.3 deg. and the ability of this air to absorb heat will depend on this rise of temperature and its specific heat. If the specific heat is taken as 0.245 B.t.u. then the number of pounds of air to be circulated per minute in order to absorb the sensible heat will be $\frac{5{,}883}{14.3 \times 0.245} = 1{,}680$ lb. As the air entering the fan is saturated with moisture the volume of one pound of air will be 13.03 cu.ft. and the total volume required of the fan will be: $1{,}680 \times 13.03 = 21{,}890$ cu.ft. per min.

The calculation above was only for the purpose of estimating the size of the fan. The heat absorbed by the air is not the refrigeration required of the refrigerating plant, but is only about one-half of the required amount. In the present problem a certain amount of the air has to be renewed, and a certain amount may be recirculated. Suppose 10 per cent is fresh air, and 90 per cent is recirculated and cooled from the conditions of 60 per cent humidity and 65

deg. F. dry bulb to 50.7 deg. The fresh air is cooled from 95 deg. F. dry bulb and 76 wet bulb to the same temperature of 50.7 deg. The total heat in either case will be found by going upward from the wet bulb temperature (100 per cent humidity line) on Fig. 2, to the total heat line and then reading the total heat from the corresponding point on the scale:

The total heat at 76 deg. wet bulb, 38.7 B.t.u.; the total heat at 50.7 deg. wet bulb, 20.75 B.t.u.; heat removed per 1 lb. air, 17.95 B.t.u.

The total cooling of the fresh air will be: $0.10 \times 1{,}680 \times 17.95 = 3{,}020$ B.t.u.; the total heat at 56.7 deg. F. wet bulb, 24.1 B.t.u.; the total heat at 50.7 deg. F. wet bulb, 20.75; heat removed per 1 lb. of air, 3.35 B.t.u. The total cooling of the recirculated air is $0.90 \times 1{,}680 \times 3.35 = 5{,}065$ B.t.u.

A certain amount of moisture will enter the air in the room, which will tend to increase the moisture content. This will be condensed in the spray chamber and will add this much more to the refrigerating load. The amount of the moisture entering with the air of infiltration is:

$$\frac{204{,}300}{5 \times 60} = 681 \text{ cu.ft. per min.}$$

The volume of one pound of air at 95 deg. F. and 42 per cent relative humidity is equal to $13.98 + (0.82 \times 0.42)$ or 14.32 cu.ft., but this air is chilled on reaching the inside of the room. It will be chilled to 65 deg. F. saturated with moisture, in fact a few grains of moisture will be condensed. Assuming that the entire 108 grains continues in each pound of dry air the pounds of air entering per minute will be: $681 \div 13.50 = 50.5$ lb. of air, and the moisture content condensed in the spray chamber will be $\frac{(108 - 55) \times 50.5}{7{,}000} = 0.382$ lb. As only 90 per cent of the air in the room is recirculated the refrigeration required is $0.90 \times 0.382 \times 1{,}060 = 364$ B.t.u. To these must be added the latent heat of the operators, $0.9 \times 500 \times 3 = 1{,}350$ B.t.u., heat effect of the water circulating pumps (estimated) at 5 hp. = 212 B.t.u. and the radiation effect into the room (estimated), 50 B.t.u., or 10,061 B.t.u. To this is added 5 per cent for safety, 503, which makes 10,564 B.t.u. per min., or 52.8 tons of refrigeration. The water in the spray chamber is heated from 43 to 51 deg. and the amount of water required will be: $10{,}564 \times 8.3 \times 8.0 = 159$ gal. per min. and the circulating system should be designed for at least 180 gal. per min. so as to carry any overload for a short time should occasion demand it.

Designing Spray Chambers

Having found the refrigerating load for the room to be 52.8 tons, the amount of air to be cooled to be 21,900 cu.ft. per min. and the amount of water to be pumped through the sprays to satisfy the conditions of the problem to be 180 gal. per min., the next step is to determine the amount of surface required in the spray chamber and the sizes of the various pieces of apparatus to be used in the spray chamber. With the temperatures required in this type of cooling, water is always used for cooling the air, and a form of spray nozzle is used that will atomize the water. Cooling coils in the spray chamber may or may not be used (kept wet by means of flooding nozzles) in order to assist in the cooling of the air. In the case here discussed the sprays only will be used, and the eliminator plates, provided to remove the surplus water carried in the air, will be provided with special flooding nozzles in order to keep them clean, and to increase their efficiency. The smaller air cooling plants may have a Baudalot water cooler directly underneath the spray chamber, so arranged as to be flooded by the water passing out of the spray chamber, in a manner similar to the method used with atmospheric condensers receiving water from cooling towers and spray nozzles. The objection to this method, where ammonia is used, is that there is no particular safety from bad leaks although the ammonia passing out through a small leak would be absorbed by the water, at least for a time. This method will be used in the present design on account of its simplicity, but it should be kept in mind that the use of brine may be imperative at times. However, with the use of extra heavy pipe, first class

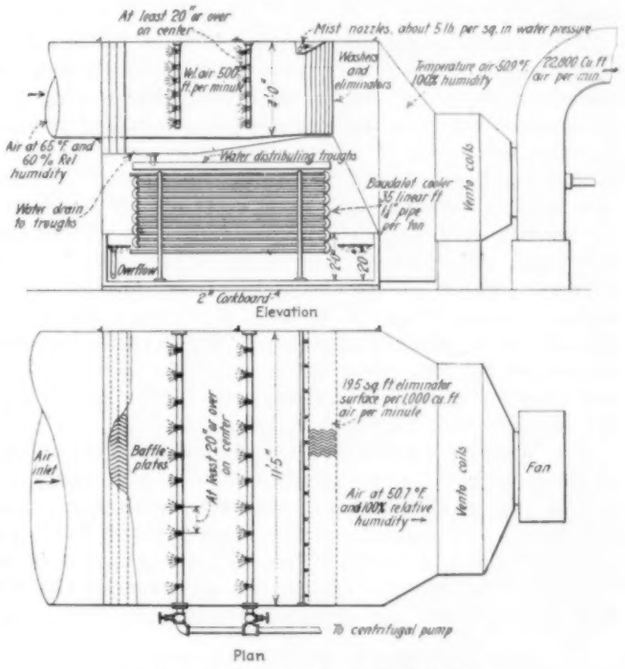

At least 20" or over on center
Mist nozzles, about 5 lb. per sq. in. water pressure
Washers and eliminators
Temperature air 50.7 °F. 100% humidity
72,800 Cu. ft. air per min.
Wet air 500 ft. per minute
10'
Air at 65 °F. and 60% Rel. humidity
Water distributing troughs
Baudalot cooler 35 linear ft. 1½" pipe per ton
Vento coils
Water drain to troughs
Overflow
20'
2" Corkboard
Elevation
195 sq. ft. eliminator surface per 1,000 cu. ft. air per minute
Baffle plates
At least 20" or over on center
11'-5"
Air inlet
Air at 50.7 °F. and 100% relative humidity
Vento coils
Fan
To centrifugal pump
Plan

Fig. 4—Spray Chamber for Air Coolers
The above drawing shows the well-known Carrier design. Other designs differ in details but the general principles are quite similar

fittings and reasonable care and inspection during erection and operation, there should not be any appreciable danger.

Referring to the table of the capacities of Carrier nozzles (Table I), it will be seen that with a $\frac{3}{16}$-in. diameter nozzle opening with a pressure of 20 lb. per sq.in., a weight of 15 lb. of water per min. will be sprayed or 1.8 gal. per min. The cooling requires 159 gal. per min. at the very minimum and 180 gal. should be allowed for, in order to provide a short time overload. There will be required, then:

$180 \div 1.8 = 100$ nozzles under a pressure of 20 lb.

$180 \div \frac{17}{8.3} = 88$ nozzles under a pressure of 25 lb.

These will be arranged in two banks, each of 50 nozzles, spaced not more than 20 in. apart, and not less than 6 in. between centers. As the velocity of the air in this part of the system must not be more than 500 ft. per min. the cross-sectional area becomes $22{,}000 \div 500 = 44.0$ sq.ft. If the head room limits the height of the chamber proper to 4 ft., then the width becomes 11 ft. Assuming that the nozzles are to be on 12-in. centers

horizontally then 10 stands will be required, each 5 nozzles high. Evidently some arrangement, say using 10 stands spaced on 13-in. centers horizontally, and

Table I—Capacity of Carrier Nozzles

Dia. of Pipe Conn.	Dia. Cap Opening	Capacity, Lbs. per Minute — Pressure on Nozzle—Lb. per Sq.In. 10	20	25	30	40	50	60	70	80	90	100
¼	7/32	0.27	0.39	0.44	0.48	0.55	0.62	0.68	0.73	0.79	0.83	0.89
¼	9/32	1.0	1.5	1.7	1.8	2.1	2.4	2.6	2.8	2.9	3.2	3.4
¼	11/32	2.3	3.3	3.7	4.0	4.6	5.2	5.7	6.1	6.5	6.9	7.3
¼	⅜	4.6	6.5	7.3	8.0	9.2	10.0	11.0	12.0	13.0	14.0	15.0
½	7/32	10	15	17	18	21	23	26	28	29	31	33
½	⅜	18	26	29	32	37	41	45	49	52	56	58
½	½	51	72	81	88	102	114	125	135	144	153	162
1	½	91	128	144	157	181	202	222	240	257	272	....
1¼	½	127	182	204	226	267	287	310	....	....	....	....
1¼	⅝	186	263	295	332	370	415	....	....	....	....	....
2	⅝	252	356	400	435	501	....	....	....	....	....	....
2	1	330	465	522	570	657	....	....	....	....	....	....
2½	1¼	515	728	815	890	....	....	....	....	....	....	....

5 nozzles high on 7½-in. centers will give satisfactory results.

If the baffle plate construction is used in order to reduce the eddy currents, give a uniform velocity to the air and prevent water from splashing out of the spray chamber, it is usual to use just enough to rectify the air, as in Fig. 4. The eliminator surface is calculated on the basis of 19½ sq.ft. (calculated for one side only) of surface per 1,000 cu.ft. of air per min., or (22,000 ÷ 1,000) × 19.5 = 430 sq.ft. of surface is wanted. The Carrier eliminator construction is with crimped gutters set vertically on 1½-in. centers, each with six corrugations at 60 deg. directional change of the air, each corrugation about 2⅜ in. wide, and arranged so that the first three will have smooth sides and corners, and the last three will have stamped lips for catching the entrained moisture.

The Webster eliminator is designed for four corrugations, with 30 deg. deflection of the air, made up of two plates, the rear one staggered with respect to the front, the separate plates spaced about 3 in. on centers, and 5 in. wide. The Webster practice is to discharge the water spray in the direction of the air flow, and to place the sprays not less than 4 ft. 3 in.

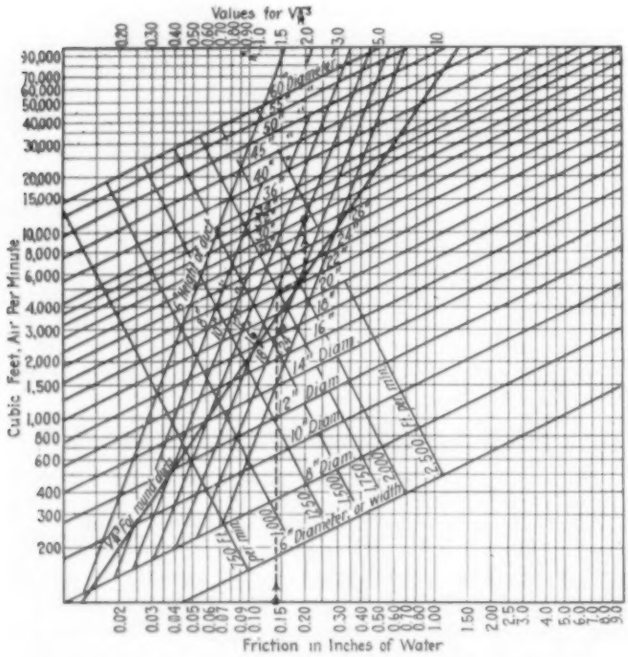


Fig. 5—Chart for Flow of Air in Ducts
This diagram shows the resistance to the flow of air at a standard temperature and pressure at different velocities of flow in a pipe

in front of the eliminators. These sprays use about 20 lb. per sq.in. pressure, and in addition "mist" nozzles are used at 5 lb. pressure for flooding the eliminator surfaces.

The American Blower Co. uses about 40 sq.ft. of scrubber surface per 1,000 cu.ft. of air per minute, spaced 1 in. apart with 35 deg. deflection of the air. These are made with plates having three corrugations and a final stamped lip. The eliminator surfaces are in three rows, the final row spaced 3¼ in., and are designed on the basis of 12 sq.ft. of surface per 1,000 cu.ft. of air per minute. The spray nozzles are designed to give a uniformly distributed spray across the spray chamber, and the spray is in the direction of the air flow.

Using the Carrier design, the eliminator surface, spaced on 1½-in. centers, becomes (132 ÷ 1½) × 6 × 2.63 × 4 ÷ 12 = 617 sq.ft. The required amount is 427

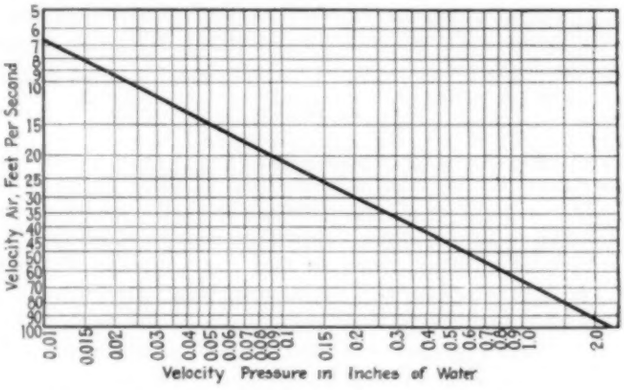


Fig. 6—Chart Showing Velocity Pressure for 70 Deg. F.

sq.ft., or there is about 43 per cent excess area over the requirements.

Fig. 4 shows the design with the water cooler directly below the spray cooler chamber. In cooling water great care must be exercised to safeguard against freezing the pipes and so the Baudalot cooler is used instead of the double pipe cooler or the shell and tube type, which would be preferred usually when cooling a non-freezing liquid. Such Baudalot coolers are usually designed on the basis of 35 linear feet of 1¼-in. pipe per ton of refrigeration. The problem requires 10,560 B.t.u. per min. or 52.8 tons. The surface, then, is 35 × 52.8 = 1,850 ft. of pipe. It is doubtful whether a cooler more than 8 ft. long could be arranged for in this type of design, so using 14 pipes high and pipes 8 ft. long the number of stands becomes 1,850 ÷ (8 × 14) = 16.5 and this can be arranged for easily on 6 or 7 in. centers. The figure gives a good idea of the entire spray chamber design. The problem has been worked out for the simplest design, i.e., a self-contained Baudalot cooler for the water, using direct expansion in these pipes for the ammonia, the entire spray chamber being located inside the room to be cooled. The spray chamber could be placed in any convenient location and the Baudalot cooler could have been cooled with the use of carbon dioxide, or brine could have been pumped in from an adjacent building.

For processes using the spray chamber it is desired to keep the product exposed to cool air and yet dry enough to prevent the surface of the product from condensing moisture. This means the selection of the proper operating temperature and relative humidity

and corresponding dew point temperature. It is necessary to supply the chilled air as uniformly as possible in order that the room temperature will be uniform throughout. This is best done by some duct system, as indicated by Fig. 3. It is proposed to circulate and chill to the dew point temperature of 50.7 deg. F., 21,890 (roughly 22,000) cu.ft. of air per minute.

In order to calculate the friction head due to the flow of the air it is convenient to use a chart as is shown in Fig. 5, showing the resistance to the flow of air at a standard temperature and pressure at different velocities of flow in the pipe. The general formula for the loss of head due to the flow of gas in pipes and ducts is:

$$h = f \frac{LP}{A} \times \frac{V^2}{2g}$$

where

h_a = loss of head due to flow in feet of the medium flowing.
h = loss of head in inches of water.
f = coefficient of friction.
L = length of pipe or duct in feet.
P = perimeter of pipe or duct in feet.
A = cross-sectional area of pipe or duct in sq.ft.
$V^2/2g$ = velocity head.
V = average velocity in ft. per sec.
d_a = density of air = 0.075 lb. per cu.ft.
d_w = density of water = 62.4 lb. per cu.ft.
g = acceleration due to gravity.

As it is customary to state this head in inches of water the above formula may be expressed as:

$$h = h_a \times \frac{d_a}{12 \times d_w} = \frac{12 d_a}{d_w} f \frac{LPV^2}{A2g}$$

which is simply an expression for the ratio of the densities of the two substances. Therefore the second expression. Using an average value of f of 0.0036 for air velocities of from 1,000 to 3,000 ft. per min., and with $L = 100$ ft., the formula becomes:

$$h = \frac{12 \times 0.075}{62.4} \times \frac{100 \times 0.0036}{64.32} \times \frac{P}{A} V^2$$

$$= 0.0000810 \frac{P}{A} V^2$$

and for round ducts $P/A = 4/D$ and h becomes:

$$h = 0.003240 \frac{V^2}{D}$$

If Q is the cubic feet per minute of air flowing, then $v = \frac{Q}{60A}$ and making this substitution the formula finally becomes

$Q = 6{,}670 \times (h)^{\frac{1}{2}} \times \left(\frac{A^2}{P}\right)^{\frac{1}{2}}$ and if the duct is round

$Q = 2{,}625\ h^{\frac{1}{2}}\ d^{\frac{5}{2}}$ (for a duct 100 ft. long, and $f = 0.0036$).

In the figure it will be noted that the quantity of air (in cu.ft. per min.) is represented by the horizontal lines and that the resistance to the flow (in inches of water per 100 ft. of length) is given by the vertical lines, whereas the different sized round ducts or the width of duct for rectangular cross-sections are given by the lines sloping upward to the right and marked diameter or width.

In all work dealing with the flow of fluids, the terms total, static and velocity pressures are used. The static pressure is that which exerts a bursting pressure on the walls of the containing vessel, and is the amount necessary to overcome the resistance to the flow of the fluid. The velocity pressure is that pressure which would be produced by the velocity if the air was brought to rest without shock or impact (and which must be used to produce this velocity). The total pressure is the sum of the two, the static and the velocity pressures. The velocity pressure (coming directly from the velocity and the density of the air) is given for 70 deg. F. by Table II and from Fig. 6.

Table IV—Capacity, Speed and Horsepower of Conoidal Fans

Size	Dia. of Blast Wheel	Area of Outlet Sq.Ft.	¼ In. Static Pres. R.p.m.	¼ In. Static Pres. Cu.Ft. per Min.	¼ In. Static Pres. Hp.	½ In. Static Pres. R.p.m.	½ In. Static Pres. Cu.Ft. per Min.	½ In. Static Pres. Hp.	1 In. Static Pres. R.p.m.	1 In. Static Pres. Cu.Ft. per Min.	1 In. Static Pres. Hp.	1½ In. Static Pres. R.p.m.	1½ In. Static Pres. Cu.Ft. per Min.	1½ In. Static Pres. Hp.
6	31½	5.25	272	7,780	1.11	334	9,525	2.03	386	11,000	3.12	472	13,450	5.80
7	36½	7.14	233	10,590	1.52	286	12,950	2.77	330	14,980	4.24	405	18,330	7.90
8	42	9.33	204	13,820	1.98	250	16,910	3.61	289	19,550	5.54	354	23,950	10.3
9	47	11.81	181	17,500	2.51	222	21,400	4.57	256	24,750	7.01	314	30,300	13.05
10	52	14.58	103	21,600	3.09	200	26,450	5.65	231	30,550	8.65	283	37,400	16.10
11	58	17.64	148	26,150	3.74	182	32,000	6.85	210	37,000	10.48	257	45,250	19.48

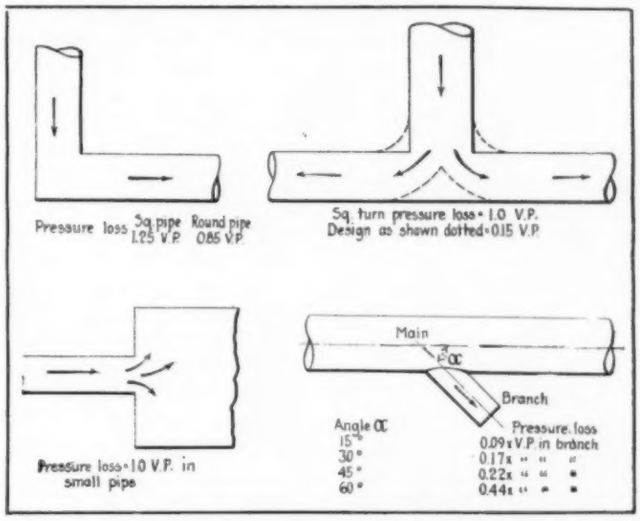


Fig. 7—Pressure Losses Due to Change in Air Flow
In the above sketches *V. P.* stands for velocity pressure and the losses are all indicated in terms of this pressure

Table II—Velocity Pressures of Air

Ft. per Min.	In. of Water	Ft. per Min.	In. of Water
750	0.04	2,100	0.28
1,200	0.09	2,400	0.37
1,500	0.14	2,700	0.46
1,800	0.21	3,000	0.57

In designing a duct system there are two general methods of procedure, either to fix on the velocity of the air in the different parts of the system taken from standard practice, and find the total pressure drop by adding up the resistances to the flow in the several sections or to select a suitable friction pressure drop near the outlet and keep this constant by selecting the duct sizes in the separate sections on the basis of this constant pressure drop and the required quantity of air flowing. The second method is the most convenient and the quickest and its application is shown by the following:

Referring to Fig. 3 it will be seen that 18 outlets are to be used. The amount of air per outlet is 22,000 ÷ 18 = 1,220 cu.ft. per min. and the velocity through a

14-in. outlet will be 1,220 ÷ (1.17 × 1.17 × 017854) = 1,135 ft. per min. Charts are usually made out per 100 ft. of straight run of pipe or duct and for ideally perfect construction and freedom from flaws. To allow for rough edges, or other faulty conditions, a factor is usually added and this is frequently taken at 50 per cent. In addition, changes of cross-section or direction of flow increase the resistance and this latter is usually given as a percentage of the velocity head. Variations such as are usual are given in Fig. 7.

Table III—Data for Designing Ducts

Section	Volume of Air in Section, Cu.Ft. per Min.	Diameter of Duct in In.	Velocity of Air in Ft. per Min.	Length of Section and Allowance for Ells, etc.
A.	2,430	17	1,620	22 ft.+0.22×0.17 in. of water
B.	4,860	24	1,610	22 ft.
C.	7,290	27	1,920	22 ft.
D.	9,720	31	1,940	22 ft.+0.15×0.24 in. water
E.	22,000	42	2,370	44 ft.
				Total=132 ft.+0.073 in water

The total resistance will be (132/100/0.14) + 0.037 = 0.258 in. of water and with an allowance for roughness, poor workmanship, etc., of 50 per cent the resistance will be 0.258 × 1.5 = 0.387 in. of water for the duct only. In addition there will be a resistance to the flow in the spray chamber of 0.25 in., and there will be a residual velocity of the air leaving the duct which will require (for 1,180 ft. per min. velocity of the air in the branch) a static pressure of 0.090 in. of water, making a total pressure on the fan of 0.727 in. of water. In designing a duct system it is usually necessary to provide for the return as well as the delivery of the air. Quite frequently the return duct will be practically a duplicate of the delivery duct, in which case there will be an additional friction to overcome and correspondingly greater total pressure. In the present case as the entire plant is located in the same room it does not appear to be necessary to put in the return duct. The design shown will work satisfactorily.

The temperature of the air is 51 deg. F. in the duct, and the calculation given above for the total pressure friction head is greater than the amount calculated (which was on the basis of 70 deg. F. air) and so a correction must be employed or $0.727 = \frac{0.742}{0.98}$ in. of water. The static pressure on the fan is some percentage of the total pressure, and taking the ratio of the total to the static pressure as 1.26 the static pressure becomes 0.742 ÷ 1.26 = 0.589. A fan must be selected for this static pressure and for a capacity of 22,000 cu.ft. per minute. The temperature of the air has been considered because the tabulated values for speed, volume and horse power of fans, in Table IV, are given for the standard temperature of 70 deg. F. The multiplying factors which must be used are as shown in Table V.

It is worth remarking that the velocities shown in the calculation (for a constant friction head drop) increase as the size of the duct increases from a little more than 1,600 ft. per min. at 17 in. diameter to a little less than 2,400 ft. per min. at 42-in. diameter. Also that the 30 deg. branch outlet resulted in the same loss of head as would have been experienced with nearly 27 ft. of 17-in. duct. Too much emphasis cannot be given to the desirability of making the number of changes in the cross section of the duct a minimum.

Table V

Temperature of Air, Deg. F.	Dividing Factor	Multiplying Factor
60	0.99	1.010
50	0.98	1.021
40	0.97	1.032
30	0.96	1.042
20	0.95	1.053

Right angled turns should be avoided at all times and when the size of the duct is to be changed it should be done gradually.

In the above calculations a round duct was chosen. Should it be desired to use a rectangular one with the same resistance per ft. of length the same chart as for the round ducts can be used, making use of the relation $Q = 6{,}670\ h^{\frac{1}{2}}\left(\frac{A^3}{P}\right)^{\frac{1}{2}}$. For example, Fig. 5 has a line labelled $\left(\frac{A^3}{P}\right)^{\frac{1}{2}}$. To use this chart suppose it is required to find the height of rectangular duct if the width of the *b* section is taken as 30 in. The quantity of air flowing in this section is 4,880 cu.ft. Take the same resistance as before, namely, 0.14 in. per 100 ft. and continue upward until the quantity 4,880 capacity is reached. Then follow parallel with the diameter lines until the line $\left(\frac{A^3}{P}\right)^{\frac{1}{2}}$ is reached and then vertically upward until the width of the duct of 30 in. is reached. This point gives the desired figure of 16 in. for the height of the duct. See dotted line on Fig. 5.

Such a fan, choosing a Buffalo planoidal plate blower-type, type L, No. 140, would give 25,200 cu.ft. per min. at 145 r.p.m., and would require 5.02 hp. A No. 10 Niagara conoidal, type N, fan at 22,000 cu.ft. per min. would require 3.22 hp. Thus the horsepower given in the calculation for the refrigeration required was nominal, and should cover the selection of any type of fan desired for the design.

Plastic Refractories

Clay refractories, furnished to the trade in plastic form, are rapidly supplanting special shapes in boiler settings and similar installations. The demand for this material for repair work is also rapidly increasing, so that at the present time it has been estimated that the total daily output exceeds 100 tons. Because of the increasing importance of this commodity to the trade, and the fact that the Government is contemplating the formation of specifications for its purchase, the Bureau of Standards undertook to determine the physical and chemical characteristics of several commercial brands of these plastic refractories.

Test specimens, made by hand-ramming in molds, were burned, subjected to standard and modified tests for fire clay refractories, and also analyzed chemically and petrographically. The information obtained indicates that plastic refractories as now furnished to the trade are inherently the equivalent of the highest grade fire clay brick.

A comparison of softening point determinations and chemical analyses by three independent laboratories shows that a variation of from one-half to one cone in softening point determinations, and more than 5 per cent on some constituents in chemical analysis, can be expected for different samples representing one brand or product.

Absorption of Ammonia in Towers

Experimental Determination of Transfer Coefficients of Absorption in Open and Various Types of Packed Towers

By O. L. Kowalke, O. A. Hougen and K. M. Watson

Professor, Assistant Professor and Fellow of Chemical Engineering, Respectively, University of Wisconsin.

OPERATING conditions in the gas and coke industry were chosen as being typical of ammonia absorption. From published data and from private communications it was found that the limits in operation of absorption towers were as follows:

Ammonia concentration of incoming gas, 0 to 1 per cent,
Ammonia concentration of solvent, 0 to 2.5 per cent,
Velocity of solvent flow, 3.9 to 15.7 lb. per min. per sq.ft. total cross section,
Velocity of gas flow, 2.8 to 9.8 lb. per min. per sq.ft. total cross section,
Temp. of gas, 55 to 170 deg. F., and
Temp. of solvent, 54 to 156 deg. F.

The unit of transfer considered most practical and used herein is defined as the number of pounds of ammonia absorbed per minute per cubic foot of tower packing under a mean ammonia vapor pressure difference of 1 mm. of mercury between the gas and liquid phases. The general formula expressing the rate of ammonia absorption in terms of this coefficient, "*ka*" is:

$$W = (ka)V\Delta P_{mean}$$

where W = lb. of ammonia gas absorbed by the entire tower per min.,
V = volume of tower packing in cu.ft., and
ΔP_{mean} = mean vapor pressure difference throughout the tower.

To use this formula, it is necessary to know precisely the value of ΔP_{mean}. That is, the vapor pressure of NH_3 must be calculated for gas and liquid phases at both ends of the tower, and the mean vapor difference accurately determined. The partial pressure of NH_3 in the gaseous phase can be calculated by multiplying the grams of NH_3 per gram of air by the ratio of the molecular weight of air to the molecular weight of NH_3, by the partial pressure of the dry air.

Data on the partial pressure of ammonia in ammonia-water solutions at different temperatures and for low concentrations are incomplete. Some are obtainable from the publications of Abegg and Riesenfeld (*Zeit. Phys. Chem.*, 1902, vol. 40, p. 84), Gauss (*Diss., Breslau*, 1900), Riesenfeld (*Zeit. Phys. Chem.*, 1903, vol. 45, p. 467), Herzen (*Bull. Soc. Chem. Belg.*, vol. 25, pp. 154-7), and Brichaux (*Bull. Soc. Chem. Belg.*, vol. 25, pp. 145-153). The following formula for the partial pressure of ammonia for dilute solutions was based on the free energy concept and the assumption that there is a direct proportionality between vapor pressure and concentration for dilute solutions:

$$\ln_e \frac{p}{m} = \frac{-4425}{T} + 10.82$$

where p = partial pressure of ammonia in atmospheres,
m = mols ammonia per 1,000 gm. water,
T = absolute temperature in deg. C.

The calculated data agree with published experimental data for molalities of ammonia to 4.5 (7 per cent NH_3), showing that Henry's law holds for these concentrations. A concentration of 4.5 mols ammonia is greater than any usually found in the gas and coke industry. It can be proved that the mean vapor pressure difference between the vapor pressure of ammonia in the gaseous phase and in the liquid phase may be expressed by the logarithmic mean. The small variation in temperature due to absorption, and the slight reductions in the volumes of gas and the solvent due to absorption, make no appreciable deviation from this mean.

The apparatus is shown in Fig. 1. The mixture of air and ammonia is forced into the bottom of the tower through a pipe, the end of which is shielded by 2 concentric cones as shown in the diagram. The purpose of the upper cone is to keep water from falling into the inlet pipe and the lower one keeps the incoming gases from being deflected against the layer of water present in the bottom of the tower. After passing up through the packing, the gas is sampled by a closed-end perforated sampling tube. A small metal shield was placed above this tube to prevent entrainment of water in the sample. The water which is sprayed into the tower comes from a mixer, thus providing a means of temperature control. The rate of water flow was determined by weighing the outlet water.

The ammonia gas was led through a trap to an orifice meter, and thence into the main air lines just ahead of

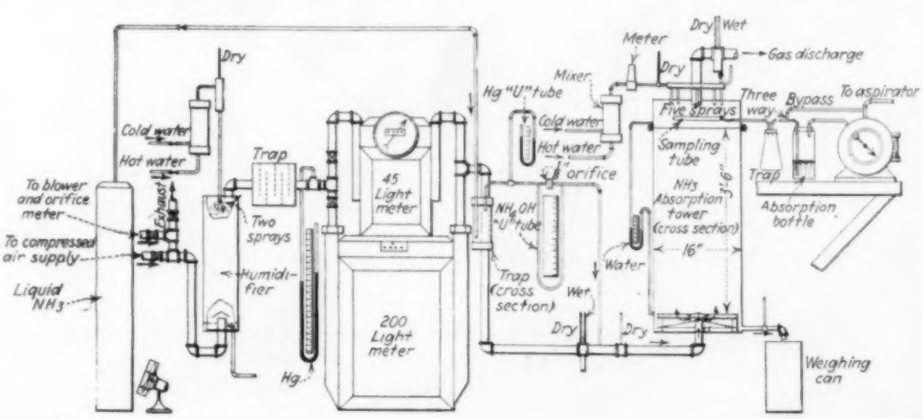


Fig. 1—Gas Absorption Apparatus

The tower proper is a heavy sheet steel cylinder 4 ft. high and 16 in. in diameter. The bottom is a steel plate tapped to receive the pipes. To the top is bolted a crown carrying 5 "Vermorel" spray nozzles arranged in an 8 in. circle. The top is easily removable for changing the tower packing. The packing is supported by a heavy screen on a wooden frame, and extends from 4 in. above the bottom to within 6 in. of the nozzles.

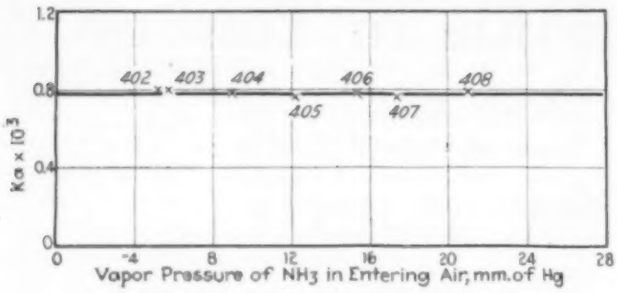


Fig. 2—Ammonia Transfer Coefficient
Variable vapor pressure of ammonia in entering air. Wood grid packing used. Ave. air flow = 0.77 lb. per sq.ft. per min. Ave. water flow = 2.5 lb. per sq.ft. per min.

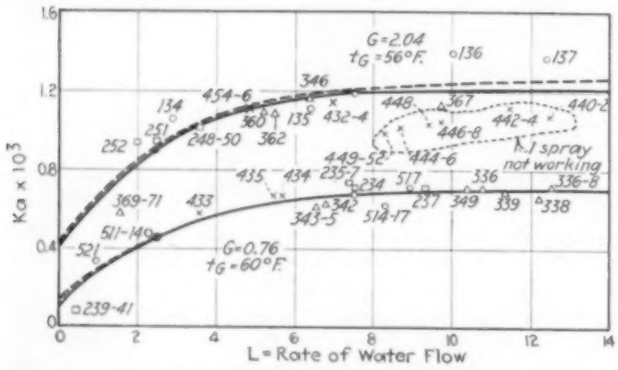


Fig. 3—Ammonia Transfer Coefficient
Empty tower packing and variable water flow. Calculated values in broken lines; experimental values in full lines.

the entrance to the tower. The orifice meter had previously been calibrated for ammonia delivery, and was used as a control and duplicate measure of the total ammonia input. The air was brought to the tower through 2 gas meters, so arranged that either or both could be used. The smaller, a 45-light size, was used for velocities up to about 15 cu.ft. per min. and the larger 200-light meter was used for greater velocities up to about 40 cu.ft. per min. For still greater velocities, the air was measured by an accurately calibrated orifice.

The first experimental work was done with apparatus set up in the form first described, with a packing consisting of 14 basswood grids. The sample of gas leaving the tower was titrated by bubbling it through a known amount of standard sulphuric acid in the wash bottle shown, noting the volume of gas required for neutralization. Sodium alizarin sulphonate was used as the indicator for the titration, as this indicator is not sensitive to carbon dioxide.

The concentration of the ammonia in the liquid leaving the tower was determined on samples taken at intervals and titrated with standard sulphuric acid.

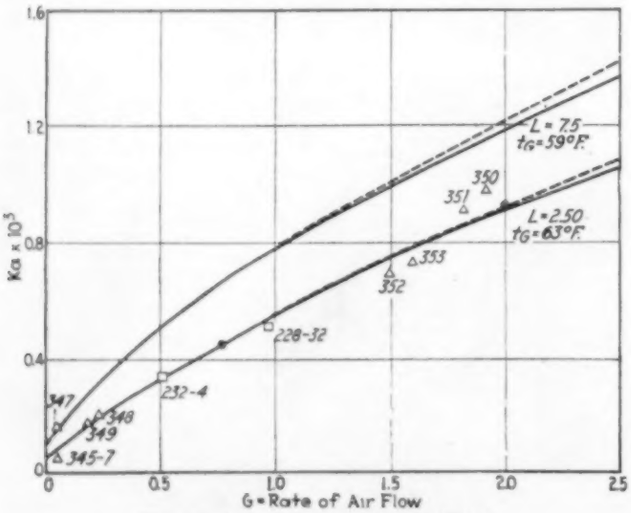


Fig. 4—Ammonia Transfer Coefficient
Empty tower packing and variable air flow. Calculated values in broken lines; experimental values in full lines.

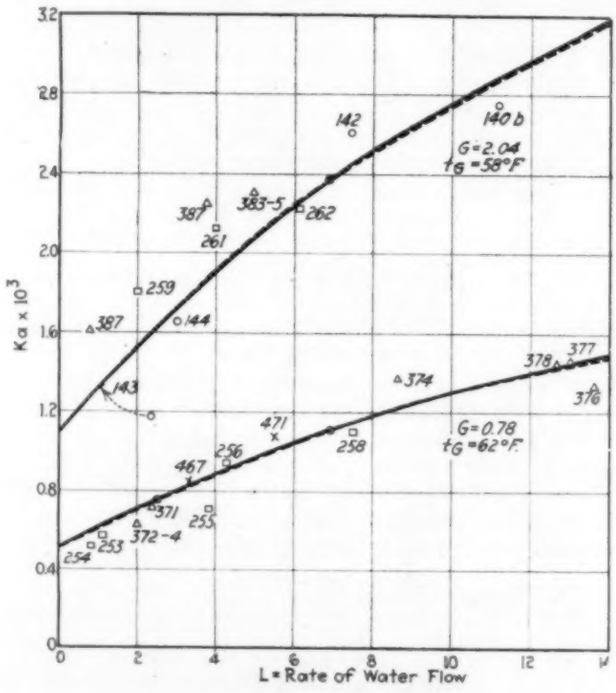


Fig. 5—Ammonia Transfer Coefficient
Stoneware packing and variable water flow. Calculated values in broken lines; experimental values in full lines.

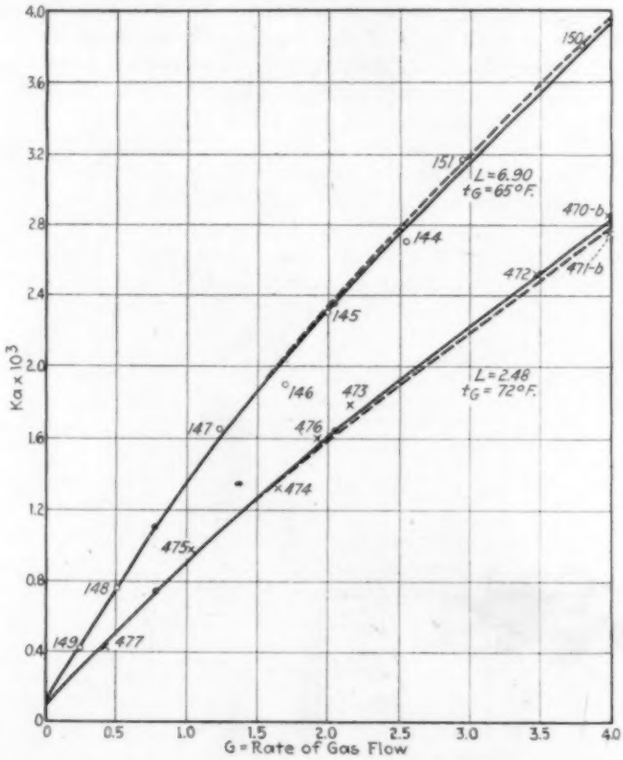


Fig. 6—Ammonia Transfer Coefficient
Stoneware packing and variable rate of gas flow. Calculated values in broken lines; experimental values in full lines.

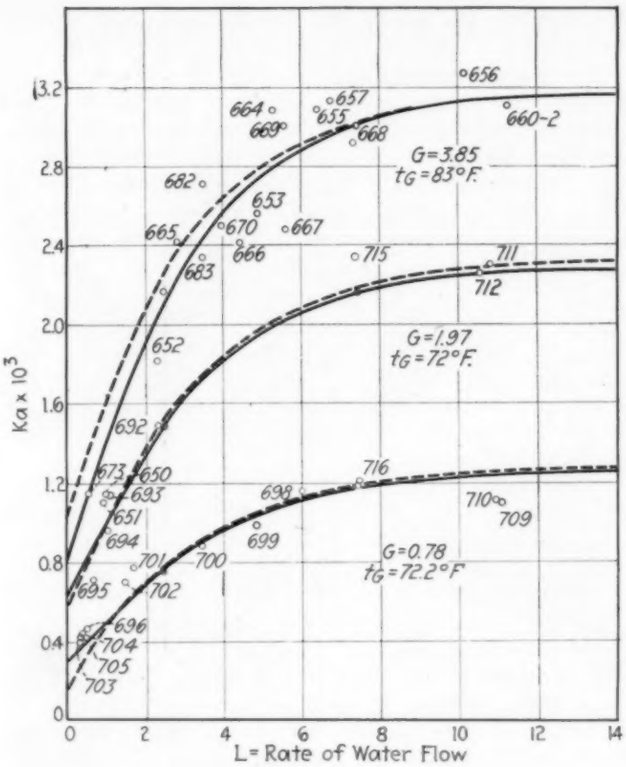


Fig. 7—Ammonia Transfer Coefficient
Stoneware packing and variable water flow. Calculated values in broken lines; experimental values in full lines.

From the above titration and the weight of the liquid leaving the tower during a run, the total ammonia absorbed and leaving in the solution was computed. The total ammonia entering the tower during the same time is the sum of that in the liquid and the amount leaving in the gas, which may be computed from the gas titration and the total volume of air passed. A check on this total input was obtained by means of the ammonia orifice. From this value the partial pressure of the ammonia in the incoming air was obtained.

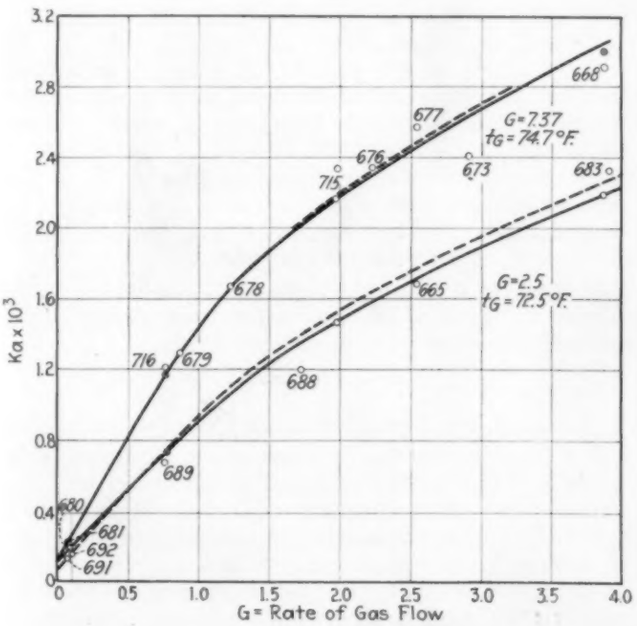


Fig. 8—Ammonia Transfer Coefficient
Stoneware packing and variable rate of gas flow. Calculated values in broken lines; experimental values in full lines.

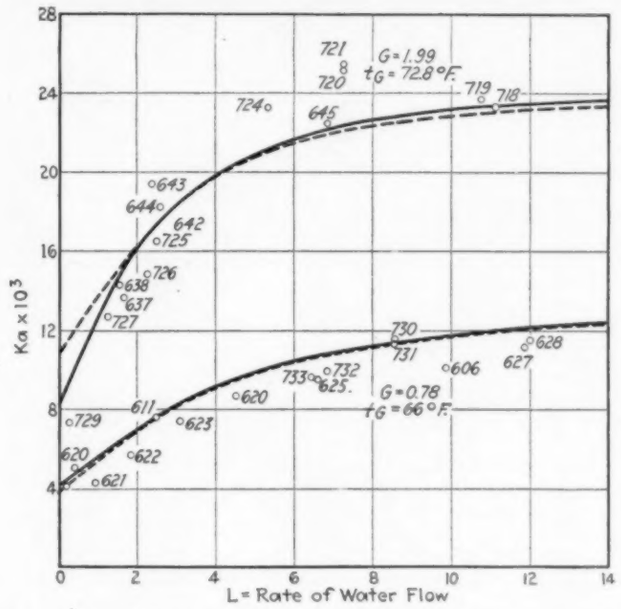


Fig. 9—Ammonia Transfer Coefficient
Paraffined wood grid packing and variable water flow. Extrapolated values in broken lines; experimental values in full lines.

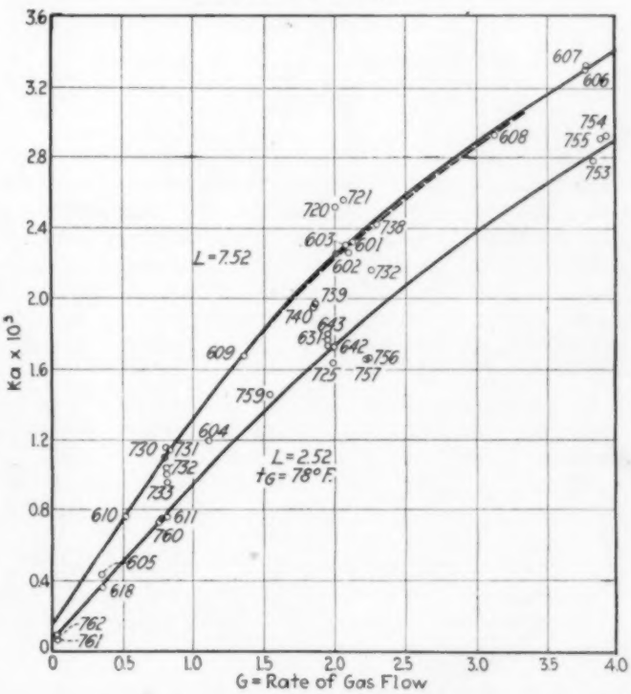


Fig. 10—Ammonia Transfer Coefficient
Paraffined wood grid packing and variable rate of gas flow. Calculated values in broken lines; experimental values in full lines.

Thus the necessary values are determined for calculating the mean vapor pressure difference. The logarithmic mean formula is:

$$Vp_m = \frac{Vp_b - Vp_t}{\ln \frac{Vp_b}{Vp_t}}$$

Where, Vp_m = mean vapor pressure difference,
Vp_b = vapor pressure difference at bottom of tower,
Vp_t = vapor pressure difference at top of tower.

The value of the absorption coefficient may then be computed from the general formula previously given.

Preliminary experiments were made on a wood grid packing. It was found that a time lag existed due to absorption and release of ammonia by the wood.

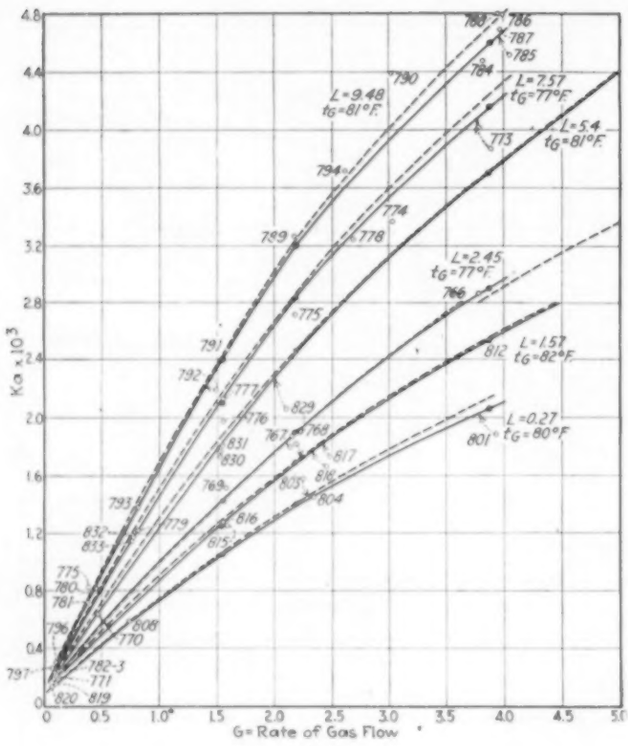


Fig. 11—Ammonia Transfer Coefficient
Quartz packing and variable rate of gas flow. Calculated values in broken lines; experimental values in full lines.

Another appreciable lag was caused by the fluctuations in ammonia concentration in the incoming air. This was eliminated by supplying heat to the liquid ammonia drum sufficient to maintain a uniform pressure of delivery. The time lag for the bare wood grid was found to vary from 1 to 10 hr. Because of this long period of lag, it was deemed expedient to impregnate the wood grid with paraffin, and by so doing the lag was reduced to 15 min.

To indicate the numerous precautions necessary to insure accurate and reliable results, more than 200 preliminary experiments were made before a satisfactory technique, a satisfactory standard of precision of measurement, and suitable mechanical accessories were developed.

A series of experiments, Fig. 2, show that variation in concentration of ammonia in the incoming gas had no effect on the value of "*ka*." The following types of packing were investigated:

Simple Spray Chamber—Water was introduced through 5 "Vermorel" sprays at the top of the tower.

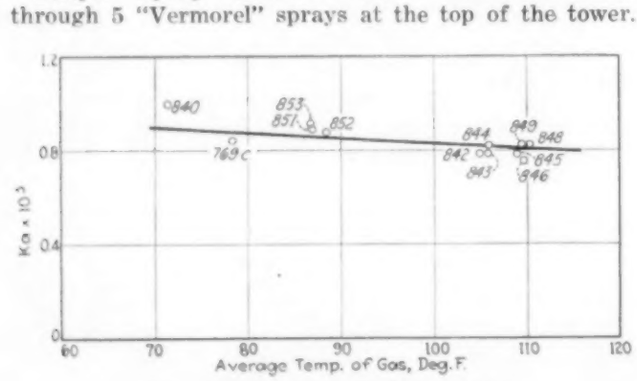


Fig. 12—Ammonia Transfer Coefficient
Variation with temperature when gas rate = 0.77 lb. per sq.ft. per min. and water rate = 2.50 lb. per sq.ft. per min.

No packing was used. Volume = 5.26 cu.ft.; effective height = 3.8 ft.; cross-section = 1.39 sq.ft.

No. 1—Stoneware Packing—Volume = 4.75 cu.ft.; height = 3.42 ft.; cross-section = 1.39 sq.ft. This packing consisted of 130 4-in. glazed stoneware rings arranged in 13 layers with 10 rings in each layer. One ring in each layer was split to make the packing more compact. Rings in adjacent layers were staggered to minimize channeling. Total exposed area per cu.ft. of packing = 22.0 sq.ft.

No. 2—Stoneware Packing—Volume = 4.63 cu.ft.; height 3.34 ft.; area = 1.39 sq.ft. This packing consisted of unglazed stoneware cylinders, 3 in. in diameter and 3 in. high with a corrugated outside surface and a spiral ledge on the inside. Weight per cu.ft. = 53 lb.; number of units per cu.ft. = 59; area per cu.ft. = 30.0 sq.ft.

Paraffined Wood Grids—Volume = 4.78 cu.ft.; height = 3.44 ft.; area = 1.39 sq.ft. Fourteen basswood grids impregnated with paraffin, 3 in. high each, and 16 in. in diameter. Consisted of ½x3-in. strips placed on edge and separated by ½-in. spacers. Area exposed per cu.ft. of packing = 32.2 sq.ft.

Quartz—This packing consisted of closely graded quartz, sized to pass a 1¾-in. screen and be retained on a 1¼-in. screen. Volume = 4.69 cu.ft.; height = 3.38 ft.; cross-section = 1.39 sq.ft.; weight per cu.ft. = 87.5 lb.; number of units per cu.ft. = 626; estimated area of packing per cu.ft = 30.0 sq.ft.

The results of all tests are shown graphically in Figs. 3 to 12 inclusive.

Early in the experimental work it was noticed that slight variations in temperature of either the gas or the liquid did not seem to alter the values of the ammonia transfer coefficient within the range of experimental error. However, a series of runs was made to determine the general trend of the temperature effect upon the ammonia transfer coefficient. In this series, the rate of air flow, water flow and ammonia concentration in the incoming air were held constant at 0.77 lb., 2.50 lb. and 17 mm. pressure respectively. The temperature was controlled by varying the temperature of the inlet water from 70 to 160 deg. F., thereby varying the average temperature of the gas in the tower from 70 to 110 deg. F. Insufficient data were taken on the temperature effects to warrant any mathematical relationships, but in general it was found that increasing the temperature diminished the values of the ammonia transfer coefficient at 70 deg. F. in the ratio of 0.25 per cent reduction for each degree rise in temperature. This corresponds closely to the change in viscosity of air over the same range.

In another article, to follow soon, the authors will develop a theory of absorption for ammonia in water, and will also discuss practical applications.

Lime for Bleaching Powder

The Interdepartmental Conference on Chemical Lime is engaged in the preparation of specifications for lime employed in various chemical industries. It was found necessary in the preparation of specifications for lime to be used in the manufacture of bleaching powder, to undertake several investigations to determine the properties which such a lime should possess. This work has been undertaken by several agencies including the Bureau of Standards.

Advanced Training in Gas and Fuel Engineering

Graduate Course Established at Massachusetts Institute of Technology in Response to Demand of Industry for Specialists

RECOGNIZING the urgent need for men thoroughly trained in the principles of gas and fuel engineering, the Massachusetts Institute of Technology has established a graduate course of instruction that is perhaps the most inclusive program of this sort offered by any educational institution. The course comprises: 1 academic year of lectures and recitations followed by 6 months of practical work at field stations operated in co-operation with industrial organizations.

The plan and subject matter of the course presupposes an education in the fundamentals of mechanical, electrical or chemical engineering, or in physics or chemistry, and including a familiarity with heat engineering and applied mechanics. On the satisfactory completion of the course, the degree of master of science in gas and fuel engineering will be awarded, and ample provision has been made for further study leading to the doctorate.

A schematic outline and detailed description of the master's course follows:

Principles of Gas and Fuel Engineering I—A quantitative study of (1) the measurement of fluid flow through pipes and ducts; (2) the flow of heat in coolers, heat exchangers, condensers and furnace walls and (3) crushing, grinding and sizing of solids.

Public Utility Management and Finance I—The theoretical and practical phases of public utility management, including corporate organization, administrative control, regulation, financing methods and accounting.

Development and Use of Power—A lecture and reading course on gas, electric and water power, including the selection of equipment for power plants. Steam turbines, the economics of oil and gas engines, and the simultaneous production of power and process steam are among the problems discussed.

Principles of Gas and Fuel Engineering II—A study of absorption, distillation and humidification as applied to the quantitative solution of problems in gas manufacture, petroleum refining and coal carbonization. Fundamental principles of operation, economic balance and the utilization of residual products form a part of the course.

Furnace and Retort Design—A series of lectures and recitations on heat transmission, flow of gases in furnaces and the principles of furnace and retort design and construction followed by practice in the design and layout of several units of equipment.

Secondary Fuels—This course is a study of the chemistry, operating variables and equipment in the making of producer gas, water gas, oil gas and the complete and low-temperature gasification of coal.

Heat Measurements—Methods of measuring temperature, thermal conductivity of materials, heat of combustion of coal, petroleum and gas are studied in the classroom and then verified experimentally. Special problems include the effect of radiation on true measurement of temperature and the loss of heat from furnace walls.

Economic Geology of Coal and Petroleum — A lecture course comprising the geologic relation of coal and petroleum deposits, the valuation of oil-bearing land, and the construction of maps.

Properties of Materials—This is a study of the chemical and physical properties of materials of construction, such as refractories, insulators, and metals. Allied problems, such as the corrosion of metals, especially of condenser tubes, heat-exchangers, boilers and stills, and water softening receive special attention.

Public Utility Management and Finance II—A continuation of the first term work, and comprising public relations, rate-making, capitalization of assets, depreciation, reserve funds, property valuation, monopoly, competition and market analysis. In this course, the general principles of public utility economics will be discussed by members of the faculty, supplemented by a program of special lecturers of wide reputation in their several fields.

Professional Prerequisites — Depending upon previous training, the student will select from the following basic courses: (a) applied mechanics, (b) structures, (c) heat engineering, (d) power plant design and equipment, (e) direct current and machines, (f) alternating current and machines, (g) gas and fuel analysis, (h) thermo-chemistry for engineers, (i) machine tool work and (j) elementary geology.

Field Work and Thesis—(a) Buffalo station: This part of the field work will be done at the Buffalo station of the School of Chemical Engineering Practice, located at the Lackawanna Works of the Bethlehem Steel Co. This station now affords experience in the use of fuels for making producer gas, coking, power generation and in ferrous metallurgy. The water gas and coal gas plants of the Iroquois Gas Co. are to form part of this station. The Woodhall-Duckhan retorts at the Iroquois plant are specially equipped to study coal carbonization. This plant also offers opportunity for studying the technical problems of utilizing mixed natural gas, coal and water gas and coke oven gas.

(b) Boston station: The manufacture of coal gas in various retorts, carburetted water gas, and the large scale distribution of gas will be studied at gas plants in Massachusetts, where unusual opportunity exists for illustrating the principles of operating and marketing. Steam power generation and the utilization of process steam will also be studied at this station. Particular stress will be laid on the student's power of original investigation as illustrated by his thesis, which will be done at one of the field stations.

In the field, the student becomes familiar with plant equipment and actual operating conditions, he works under the supervision of regular instructors of the Institute and he receives no pay, hence there are no definite obligations to the company. The whole plan of field work has a marked similarity to that used with such undisputed success in training physicians and surgeons—whereby the young medical graduate serves an internship before starting the regular independent practice of his profession.

As soon as the enrollment and finances of the course warrant, the scope of the field work will be broadened to include at least 1 representative plant in each of the following fields: Oil refining, central power station and ceramics. The enthusiasm and support which the plan has been accorded by industrial administrators is a guarantee of financial aid in the form of fellowships, direct co-operation in establishing field stations and the satisfactory placement of deserving graduates.

First Term

Subject	Credit Hours
Principles of Gas and Fuel Engineering—I	150
Primary Fuels	90
Combustion	90
Public Utility Management and Finance—I	90
Development and Use of Power	90
Gas Engine Laboratory	45
Professional Prerequisites	195
Total	750

Second Term

Subject	Credit Hours
Principles of Gas and Fuel Engineering—II	150
Furnace and Retort Design	135
Secondary Fuels	90
Heat Measurement	90
Economic Geology of Coal and Petroleum	90
Properties of Materials	60
Public Utility Management and Finance—II	90
Professional Prerequisites	45
	750

Field Work

Subject	Credit Hours
Field Work at Buffalo and Boston Stations	720
	720

On the Engineer's Book Shelf

Technical Writing

COMPOSITION OF TECHNICAL PAPERS. By *Homer Andrew Watt*, professor of English, Washington Square College, New York University, and *Philip B. McDonald*, assistant professor of English, College of Engineering, New York University. Second edition, 430 pp. New York: McGraw-Hill Book Co., Inc. Price, $2.

Of all the tools available to them, most engineers are least familiar with the proper use of the most important—language. The majority of them would rather build a bridge or construct a plant than write about it. Yet, as a well-known New York engineer once remarked, "An engineer who is inarticulate is quite as useless as one who is professionally incompetent."

Recently the schools where engineering is taught have been trying to remedy this state of affairs by offering courses of training in English composition. It is for the purpose of being helpful to engineering students and their teachers that this book is published. The value to the practicing engineer of a training in English composition is set forth, for if he cannot express himself clearly, his verbal orders will be misunderstood, his reports will fail to convince and his business letters will be slovenly.

How a technical composition is built up is shown, and examples are given of how and how not to handle a subject. The last half of the book explains and illustrates some of the more specific principles that govern the composition of the types of exposition with which engineers are most concerned—technical descriptions, expositions of processes, expositions of ideas, reports and business letters.

The book is evidently intended for use as a textbook, but it might well be read by every engineer and then be placed conveniently at hand where it can be reread at frequent intervals. CHARLES N. HULBURT.

Chemistry of Storage Batteries

STORAGE BATTERIES. By *G. W. Vinal*. 402 pp. John Wiley & Sons, Inc., New York. Price, $4.50.

Reviewed by Helen Gillette Weir

In this work Dr. Vinal has made a valuable contribution to the literature of storage batteries. In fact, it is unquestionably the most complete reference work available for battery technologists, representing as it does, a complete compendium, aside from certain manufacturing secrets, of present-day theoretical information and industrial practice.

The comprehensive manner in which the subject has been treated is evidenced by the titles of the subdivisions: materials and methods of construction; the electrolyte; theory of reactions; energy transformations and voltage; capacity; operation; resistance; testing; and present-day uses. Numerous references are made to original papers, thereby giving an excellent bibliography to the student of batteries. Also, data of tests at the Bureau of Standards and a description of the methods and apparatus are included.

Both the theoretical and practical aspects of battery performance are fully treated and the development of the theory is clear and sufficiently elementary to interest the non-technical reader. There are no new theories advanced in regard to battery behavior but an interesting expression for the rate of diffusion of the acid has been deduced from the gas laws. Unfortunately, its application is explained only qualitatively. It would be interesting to see it extended to a quantitative application of the effect of diffusion on capacity.

There is little in the way of adverse criticism of the book to be said. However, most readers would find it more conveniently arranged if all the characteristics of the Edison batteries had been treated in one section. Under "Sources of Trouble," the distinction between failure of lead batteries in operation due to poor manufacture and those directly attributable to abuse in use is not sufficiently emphasized. Probably the greater proportion of prematurely short-lived batteries belong to the former class and can be traced directly either to faulty construction of the plates or to poor assembly of the cell.

In bringing forth evidence to support the double sulphate theory of reaction, the recent work of Cassel and Tödt should by all means have been mentioned. Their results were obtained under conditions which assured the complete equalization of the acid in the pores of the plate and, in the reviewer's opinion, so conclusively showed the correctness of the double sulphate theory as to leave no further room for doubt. Dr. Vinal finds that Peukert's formula $I^n t = C$, is superior to the other formulas for expressing the relation between ampere hour capacity and rate of discharge for starting and lighting batteries. However, it should be said that the value of the comparison of the various formulas is somewhat vitiated by neglecting to state the accuracy of the capacity data used. It can not be safely assumed that there is an error of constant magnitude in the determination of capacities at different rates.

Crystals and the Structure of Matter

CRYSTALS AND THE FINE-STRUCTURE OF MATTER. By *Friedrich Rinne*, professor of mineralogy in the University of Leipsic: translated by *Walter S. Stiles*. Second edition, enlarged, 195 pages. E. P. Dutton and Co., New York. Price, $4.20.

This is a second edition of a widely recognized book. The addition of historical background, diagrams, and portraits of some leading scientists in this branch of physics has increased the appeal of the work to general readers. An attempt has been made to deduce from the properties of crystals the principal characteristics of the fine-structural constitution of matter, quite apart from an exposition of fundamentals based upon the work of Laue, Friedrich, Knipping, Bragg, Moseley and Scherrer. The book is commendable in that it can be read with ease, but at the same time there is nothing superficial about the style of treatment.

Books on Rubber

Outline of Important Works on Chemical Technology and Plantation Methods

By George Calingaert
Chemical Engineering Department, Massachusetts Institute of Technology

The following is a short list of selected books for those interested in the technology and growing of rubber. The general scheme of this summary is to go from the theoretical to practical phases of the subject.

C. O. Weber, "The Chemistry of Rubber," London, 1912—An epoch-making book in this field. Recent developments have rendered it somewhat incomplete, but the data and discussion it contains, especially on the chemical theory of vulcanization, makes it a classic of rubber chemistry. Treats of the properties of the rubber hydrocarbon and resins, of the examination of compounding agents, of rubber solvents and rubber analysis. Does not cover the chemistry of organic accelerators, as they were practically unknown at that time.

P. Schidrowitz, "Rubber," D. Van Nostrand Co., New York, 1920—A treatise and book of general information on the subject. Describes plantation growing, vulcanization and manufacture, and discusses the theories involved, the present situation and evolution of the rubber industry. Complete and thorough, and yet attractive in style.

D. W. Duff, "The Chemistry of Rubber," London, 1923—A comprehensive book. Descriptive enough on methods of growing and vulcanization to make clear the complete study the author makes of the chemical properties of rubber and its ingredients.

G. S. Whitby, "Plantation Rubber and the Testing of Rubber," London, 1920—A reference work on the subject; perhaps the best book on the preparation of plantation rubber. Methods of growing and the physical testing of rubber are treated thoroughly and comprehensively. Indexed references make the book useful for the research man. Touches lightly on chemistry and chemical testing, but studies in detail the change in physical properties with the degree of vulcanization.

C. W. Bedford and H. A. Winkelman, "Systematic Survey of Rubber Chemistry," Chem. Catalog Co., 1923—The harvest of a thorough survey of the literature. All the data are arranged in short abstracts instead of mere references, with convenient cross-indexes such as author, subject and patent number. Deals only with the chemistry of rubber, omitting methods of analysis, synthetic, and reclaimed rubber. Two illuminating articles are given, setting forth a clear picture of the present day status of organic accelerators and the theories of vulcanization. An invaluable book for the research chemist.

J. B. Tuttle, "The Analysis of Rubber," Chem. Catalog Co., 1922—Gives enough information regarding the properties of rubber to familiarize the technical man with the chemistry of rubber. Gives the methods of analysis and testing, as well as their significance and importance for the producer and consumer.

A. Heil and W. Esch, "The Manufacture of Rubber Goods," London, 1919—Studies the layout of the plant and describes the equipment used for handling crude rubber, vulcanizing, mixing and the manufacture of soft and hard rubber goods.

H. E. Simmons, "Rubber Manufacture," London, 1922—A good book of introduction. Describes the cultivation, chemistry and testing of rubber. Discusses in a simple way the theory and purpose of the various steps. Attractive reading and perhaps the best book to give the layman a clear picture of the rubber industry.

A series of highly specialized books on rubber technology by *H. C. Pearson*, has been published by the "India Rubber World." They are comprehensive and complete, and useful to the man in production work. Two of the most recent ones are: "Rubber Machinery" and "Rubber Tires."

Management Sharing

SHARING MANAGEMENT WITH THE WORKERS. By *Ben M. Selekman*, department of industrial studies of Russell Sage Foundation. 142 pp. New York: Russell Sage Foundation. Price, $1.50.

Readers of this book who are at the same time industrial exectuives will be delighted to find an account of an actual experiment in management, one that has been in operation 6 years. The idea of sharing management at the plant of the Dutchess Bleachery, Wappingers Falls, N. Y., had its origin in the difficulty of administering a host of small problems relating to housing and personnel. Gradually, more and more responsibility fell to the workers, and along with responsibility of management went a knowledge of company finances and equal sharing in the profits in excess of 6 per cent on a fair capitalization.

The plan came neither from stockholders nor workers; it was a gradual evolution, the product of several years cautious experimenting. Some of the tangible results of the plan have been: Improved housing conditions, a community educational and recreational program, a substantial increase in productive efficiency, increased earnings for workers and capital stock and decreased labor turnover.

The author has included the essential statistical data relating to wages, profit-sharing and working hours and the book is really a practical manual for those interested in the management of personnel.

Science in Industry

SCIENCE IN INDUSTRY. Radio Publication No. 9. University of Pittsburgh, Pittsburgh, Pa. 40 pp. Price, 60c.

A series of talks on "Science in Industry" recently broadcast from the University of Pittsburgh is now available in pamphlet form. The topics are: Functions of science in industry, iron and steel, natural gas, petroleum, coal and coke, glass and clay products. The speakers, all of the staff of the Mellon Institute, have succeeded admirably in bringing the technology of industry to the layman in a clear, accurate and interesting manner.

Industrial Chemistry of Cotton-Cellulose

COTTON-CELLULOSE: ITS CHEMISTRY AND TECHNOLOGY. By *A. J. Hall*, chief chemist, the Silver Springs Bleaching & Dyeing Co., Ltd. 228 pages. D. Van Nostrand Co., New York. Price, $7.50.

This book aims at the difficult goal of treating the subject of cotton cellulose chemistry in a comprehensive, yet concise manner. It is questioned whether this is a desirable way of treating a subject so broad. However, a distinctly worth-while guide to the recent literature of cotton cellulose has been produced by the author. The reactions to alkalis, acids, oxidizing agents, and dyes, are described well.

Gasoline from Natural Gas

THE RECOVERY OF GASOLINE FROM NATURAL GAS. By *George A. Burrell.* American Chemical Society Monograph. 600 pp. 141 tables, 218 figures. Chemical Catalog Co., New York. 1925. Price, $7.

Reviewed by Paul D. V. Manning

The recovery of gasoline from natural gas, an industry started in 1903 and having in 1924 a total capital investment of $150,000,000 in its 1,200 plants, has had previously almost nothing in the way of a literature. This is more remarkable when we consider that this industry produces 7 per cent of the total gasoline consumed in the United States.

For this reason, this book is especially welcome and more so because the author brought to his task the rare combination of sound theory and actual practice in commercial operation as well as a knowledge of the development of the industry gained by personal contact.

This is all the more fortunate from the reader's standpoint for although the subject of gasoline recovery is comparatively new, the use of activated carbon as a medium of recovery in this and in other allied arts, such as solvent recovery, is much newer. This is the first authoritative work in book form that covers this important field and the author does well to set forth the facts regarding the use of activated carbon. This part of the book should make it useful to many readers who are not interested in the actual recovery of gasoline.

The statistics of the industry, vernacular, history and occurrence of natural gas form the subject matter for the first 4 chapters. One chapter then gives a summation of various theories as to the origin of petroleum. Other authors are here extensively quoted, a statement from the unpublished work of R. H. Johnson being interesting. He holds that the origin of petroleum is in the shales adjacent to the sandstone where the oil is usually found.

The first recovery plant was of the compression type built by small operators in 1904. The author became interested in this work in 1915 and with G. G. Oberfell built the first charcoal type of plant in 1918.

Two chapters relating to the application of vacuum to gas wells and the question of gas leases are followed by 5 chapters on the chemistry of natural gas, its analysis, testing, measurement and yields of various fields. The specific gravity of methane should be given as 0.554. The statement on p. 74 that plants take up oxygen, giving off carbon dioxide as do animals, is rather startling unless one continues and reads, "though an action which is in a general way a reversal to this takes place at the same time, in that certain substances in the leaves of plants have the power of taking up carbon dioxide." The analysis of natural gas is described in detail. The use of activated carbon for the determination of the gasoline content of natural gas is a convenient test and has found many useful applications in other industries. Under the head of gas measurements, orifice tables are included but no mention is to be found of the Thomas meter. The importance of applying corrections for the deviations of the gases from Boyle's law is emphasized.

Our attention is next occupied by the various commercial methods of gasoline recovery. The compression system both without and with supplementary refrigeration is being replaced by oil and charcoal absorption systems. While it is true that the war gave great impetus to the installation of light oil recovery plants as integral parts of coal carbonizing plants, the reviewer is inclined to think that the byproduct coke oven engineer will resent the statement that "a real industry covering this practice (light oil recovery) did not develop in the United States until the Great War occurred." Some space is devoted to absorbers, stills, heat exchangers and auxiliary apparatus, giving examples of performance and construction with considerations of cost. The data on the design of absorbers are somewhat meager and no mention is made of the use of tetraline as an absorbing agent. This has found great favor in Europe recently in this type of recovery work.

After a comparison of the compression and oil recovery systems we pass on to the use of activated charcoal for recovery. This chapter is interesting and worth while as the author discusses the manufacture, theory and application in the industry. Examples of installations and methods of testing charcoals for this use are also given. The many advantages of the charcoal process would seem to make it most desirable but no information is given as to the effect of such gas impurities as hydrogen sulphide on the charcoal itself. It is interesting to note that a higher saturation of the gasoline in the carbon is obtained by passing the gas upwards through the absorber, whereas in practice the gas is usually passed in the opposite direction to avoid loss of carbon.

The importance of the fractionating column in petroleum work is just lately beginning to be realized. It would seem that this subject would merit more than 3 pages. Most of this space is devoted to the Rafferty "stabilizing" process. Likewise a more complete description with technical data on the removal of hydrogen sulphide from gas by the wet process would not be amiss.

A number of chapters are devoted to refinery practice, losses, transportation rules, handling of product, list of accidents, hazards, etc.

The reader will perhaps share the preliminary opinion of the reviewer that some of the following 9 chapters treating auxiliary equipment such as steam boilers, engines, pumps, water cooling systems, etc., have little place in this volume. On second thought, however, these chapters are justified by the fact that the author has given data which he has found necessary for efficient and economical operation. Further justification is found in the scope and field of the book.

A hint as to the author's vision of the future of the petroleum industry on page 503 reads, "We take comparatively little of the original petroleum from the sand. An innovation in petroleum winning may occur to bring a surprising percentage of this oil from the ground." No definite relation between the decline of oil production from one well and the decline of gas flow has been worked out.

The concluding chapters are given over to the motor fuels other than gasoline, the testing of gasolines, quality of gasolines made and marketed.

There are many typographical and a few other errors, but these for the most part will be readily discerned by the reader, and their presence in no wise detracts from the real value of the book. The absence of a "rehash" of patent literature is certainly commendable. The illustrations are well chosen and frequently used. The book is written to be used and certainly fills a want.

Readers' Views and Comments

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest

Adsorption of Metals by Charcoal

To the Editor of Chem. & Met.:

Sir—In articles by R. H. McKee and P. M. Horton on activated charcoal (*Chem. & Met.*, 1925, Vol. 32, pp. 56 and 164), certain results and conclusions are given that are at variance with those obtained by the writer and his associates in work on charcoal precipitation from cyanide solutions.

The statement is made that chars made with alkaline reagents are the most efficient metal adsorbents thus far discovered. The capacity figure given for black ash residue (the most efficient char quoted) is 1,940 oz. of gold per long ton of char (1,740 oz. per short ton). Pine and many other wood charcoals were made in Reno and had a gold capacity of 2,000 oz. per short ton. This, however, was the limit of capacity.

As McKee and Horton obtained a much greater capacity with black ash residue than with pine charcoal, the former is a promising product for further investigation. However, such an investigation is of little value unless there is accuracy in the determination of gold, the only reliable method being by assay. The colorimetric method based on the color of purple of Cassius is not reliable.

The gold from an aurocyanide solution is not deposited on charcoal as metallic gold. The evidence that the deposit is metallic, advanced by McKee and Horton, is not conclusive. That metallic silver is deposited on charcoal from a nitrate solution and that metallic gold is deposited from a chloride solution is no evidence that metallic gold is deposited from aurocyanide. Though McKee and Horton report that they saw metallic gold deposited on charcoal from aurocyanide, this statement is controverted by other investigators who report no visible gold. Nor was it possible to detect any trace of metal under the microscope on the many samples of charcoals that were loaded from aurocyanide solution or from argentocyanide examined by the writer. That the deposition of the metals in the metallic state on charcoal is different from the deposition from cyanide may be shown by the effect of acidity, the capacity of the charcoal, and, most important of all, by the solubility of the deposited substance. If the deposit from the aurocyanide were metallic gold, it should be soluble in aqua regia and not soluble in hot water, sodium hydroxide, or sodium sulphide; but the opposite is invariably true. Moreover, by analysis it can be shown that the material deposited on the charcoal from an aurocyanide is a double cyanide and that the alkali from the alkaline aurocyanide originally in solution remains in solution as an alkaline bicarbonate. There is also every evidence that the mechanism of the deposition on charcoal from aurocyanide or from argentocyanide is an adsorption.

The mechanism being an adsorption, and if we accept adsorption as being limited to a monomolecular layer, we have a definite limit of charcoal capacity as a "precipitant" for gold or silver from cyanide. The factors that affect charcoal capacity, then, are the available surface of the charcoal and the activity of this surface. When this capacity is reached the charcoal is unfit for further adsorption unless the adsorbed material can be removed, or the adsorbed material can be changed in the charcoal so as to be no longer adsorbed, leaving the charcoal in condition to adsorb another load.

A serious consideration in the use of charcoal as a "precipitant" from cyanide is that its capacity for gold is lowered when silver is present in solution. As the capacity of charcoal for silver from cyanide is approximately half that of gold by weight, it follows that for every ounce of silver "precipitated" two ounces less gold can be "precipitated." The statement of McKee and Horton that the total precipitating power of the charcoal is practically unchanged when "precipitating" both gold and silver, is based on a test that is not conclusive as to the ultimate effect of the silver. That silver actually lowers the gold capacity can be shown easily by subjecting an aurocyanide loaded charcoal to the action of argentocyanide, the adsorbed gold salt being removed from the charcoal as the silver salt is adsorbed.

Tests made by the writer proved also that when charcoal is given a definite heat treatment, quenching has no effect and that either wet or dry grinding of the charcoal has equally good results. JOHN GROSS.

Salt Lake City, Utah.

To the Editor of Chem. & Met.:

Sir—Replying to the letter of Mr. Gross on this subject we wish to say that apparently his criticisms are based in part on an incorrect interpretation of our work, e.g., he states that "the capacity figure" for our "most efficient char" is 1,940 oz. of gold per long ton of char. This is incorrect. This figure is a "break figure" and represents the gold adsorbed until the filtrate showed that 10 per cent of the gold in the solution was going through the char. Limiting capacity figures for chars were not given in our articles, e.g., we have had 1 sample of this char the limiting capacity of which for gold was slightly over 10,000 oz. gold per long ton char. Such a char carrying about 22 per cent is almost like old oak in color.

Criticisms of the purple of Cassius method of assay are not to the point. If our articles are reread it will be noted that the gold in the char was not determined by such an assay. We used the Cassius purple test only as an indicator to determine when gold in quantity was appearing in the filtrate. For such a qualitative test it is amply accurate.

Mr. Gross states that he and others have not seen the gold color on char prepared from aurocyanide solutions. We have, hence there is no argument.

We do not know what strength of gold solutions Mr. Gross used. If fairly concentrated solutions were used, our work predicts (*Chem. & Met.*, 1925, vol. 32, p. 165) that part of the gold would be absorbed as aurocyanide, but our evidence is that when solutions of commercial strength are used (1 gm. mol in 10,000 to 40,000 liters solution) that the gold is deposited as metallic gold.

Contrary to the statement of Mr. Gross, this adsorbed

material *is* soluble in aqua regia and slightly soluble in sodium sulphide. However, such solvents would not be expected to extract the gold quantitatively, as gold is taken up from such solutions by these very charcoals. Moreover, there is no reason to think that aurocyanide, if adsorbed, is insoluble in aqua regia, so that solubility in such reagents is really not evidence as to the form in which the gold is deposited.

Contrary to the inferences of Mr. Gross, solutions of aurocyanide comparable to those dilute dilutions used in actual metallurgical price cannot be analyzed for bicarbonate by any known means accurately enough to demonstrate "that the alkali from the alkaline aurocyanide originally in solution remains in solution as an alkaline bicarbonate." Indeed the evidence so far as it exists is against it being present as an alkaline bicarbonate.

If Mr. Gross will reread our papers he will find that we hold that the gold is held in the charcoal by *adsorption* (cf. titles of papers, and repeated many times in the test). He argues as if we advocated "a reduction theory." We have never upheld that dead and buried theory.

The statements that the total precipitating power of the charcoal is practically unchanged when precipitating both gold and silver is erroneously quoted. We showed conclusively that for each equivalent of silver (108 gm.) adsorbed, an equivalent of gold (197 gm.) cannot be adsorbed. Mr. Gross evidently got his equivalent weights and his ounces of metal per ton mixed up.

Mr. Gross says that "tests made by the writer proved also that when charcoal is given a definite heat treatment, quenching has no effect." Here we note that Mr. Gross must have a mysterious process which he is holding back from the suffering scientific and technical world. If he has something new in the way of "heat treatment" we hope he will tell it to the world. In the meantime quenching may be safely taken to improve the capacity of the char—at least in the absence of any "definite heat treatment."

RALPH H. MCKEE,
PAUL M. HORTON.
Department of Chemical Engineering, Columbia University, New York City.

Distillation of Sawdust

To the Editor of Chem. & Met.:

Sir—In your paper (*Chem. & Met.*, 1925, vol. 32, No. 3, p. 112) there is a statement that there is no commercial process for using sawdust as a raw material in wood distillation. We should like to correct this impression, as we have supplied a unit of the "Fusion" low temperature retort to one of the large sawmill companies in England for the purpose of treating sawdust. Before they decided to install this plant many tests were carried out by them or in their behalf. In the tests that we carried out we obtained 17 gal. of water-free oil per wet ton of sawdust treated, the oil having a sp.gr. = 1.127. In addition to the oil we recovered 102 gal. of acid liquor of 1.26 per cent acidity per ton of sawdust; also 2,200 cu.ft. of fixed gas of high calorific value, and a residue in the form of granular charcoal equal to 26 per cent by weight of the feed. The "Fusion" retort was described in your paper on Oct. 22, 1923.

J. F. W. PASLEY.
The Fusion Corporation, Ltd., Middlewich, Cheshire.

Recent Articles in Technical Periodical Literature

By P. K. Fröhlich
Mass. Inst. of Technology, Cambridge, Mass.

Sugar Refinery Equipment. Report presented at the second annual convention of the Philippine Sugar Association. G. H. Holden, *Int. Sugar J.*, 1925, vol. 27, pp. 42-5.

Synthetic Camphor. Review of methods of making camphor from pinene. E. Toussaint, *Rev. Chim. Ind.*, 1925, vol. 34, pp. 41-6.

Sodium Sulphide. Industrial methods of making sodium sulphide. R. Hazard, *Rev. Chim. Ind.*, 1925, vol. 34, pp. 14-17 and 46-9.

Hydrosulphite Industry. Historical and general aspects of industry and theory of hydrosulphite formation. E. Geay, *Rev. Chim. Ind.*, 1925, vol. 34, pp. 5-10.

Benzyl Alcohol and Benzaldehyde. Methods of manufacture. B. Lorges, *Rev. Chim. Ind.*, 1925, vol. 34, pp. 10-13, and 50-3.

Hydrogenation of Coal. Application of Bergius method to semi-coked lignite, whereby lignite and coal rich in volatile matter may be hydrogenated, giving oil. F. Fischer and W. Frey, *Brenn. Chem.*, 1925, vol. 6, pp. 69-79.

Purifying Solvents. Solvents may be freed from suspended matter by the Hele-Shaw stream line filter. J. W. Hinchley, *Chem. & Ind.*, 1925, vol. 44, pp. 117-23.

Electrolysis of Salt. Alkali-Chlorine manufacture at the Canadian Salt Co. plant. D. A. Pritchard and G. E. Gollop, *Chem. & Ind.*, 1925, vol. 44, pp. 220-3 and 243-6.

Steam Generation. New Benson process involving high temperature superheat. D. Brownlie, *Chem. & Ind.*, 1925, vol. 44, pp. 213-19.

Benzol Industry. Outline of the early stages of the industry. W. Irwin, *Chem. & Ind.*, 1925, vol. 44, pp. 92-4.

Internal Combustion Boiler. Submerged flame principle applied to the generation of steam for power plants and evaporation of liquors in chemical plants. O. Brunler, *Chem. & Ind.*, 1925, vol. 44, pp. 187-90.

Corrosion of Iron-Cobalt Alloys. Also application of cobalt compounds to paints, enamels and alloys. T. H. Gant, *Chem. & Ind.*, 1925, vol. 44, pp. 157-61 and 191-7.

Steam Accumulation. Discussion of principles, construction, capacity, efficiency and economy of Ruths steam accumulator. S. Hopkins, *Chem. & Ind.*, 1925, vol. 44, pp. 69-74.

Electrolytic Hydrogen. Description of the Knowles electrolytic plant supplying hydrogen to the new Claude ammonia plant at Bussi, Italy. Anon., *Chem & Ind.*, 1925, vol. 44, pp. 131-2.

Dyestuffs Industry. Some international aspects of the industry, including a survey of raw material, organization, personnel and production. W. E. Fearnsides, *Chem. & Ind.*, 1925, vol. 44, pp. 133-5.

Crank-Case Dilution. A study of crank-case dilution and the effect of rate of wear. D. P. Barnard, 4th, *Ind. Eng. Chem.*, 1925, vol. 17, pp. 278-80.

Boiler Water Treatment. A general formula has been deduced for preventing adherent scale on evaporating surfaces. Below 150 to 200 lb. gage pressure, soda ash is used, but at higher pressures, sodium phosphate is preferable for conditioning boiler water. R. E. Hall, *Ind. Eng. Chem.*, 1925, vol. 17, pp. 283-91.

Production of Organic Acids. An electrolytic method for producing commercial quantities of p-phenylene-diamine aminosalicylic acid, succinic acid and hydrocinnamic acid. J. F. Norris and E. O. Cummings, *Ind. Eng. Chem.*, 1925, vol. 17, pp. 305-6.

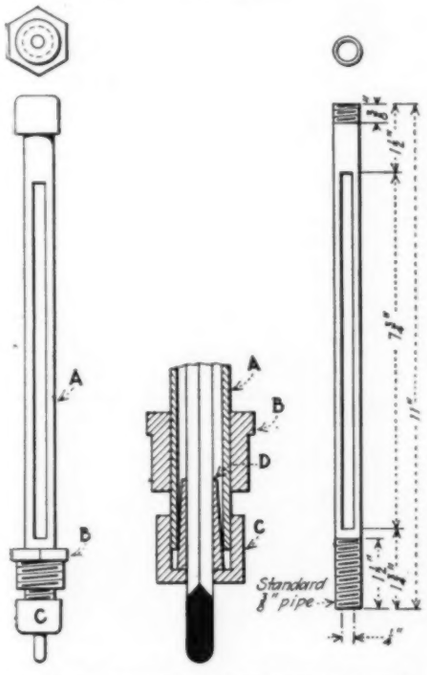
The Plant Notebook

An Exchange for Operating Men

A Method for Safeguarding Glass Thermometers

By W. L. Badger
Professor of Chemical Engineering, University of Michigan

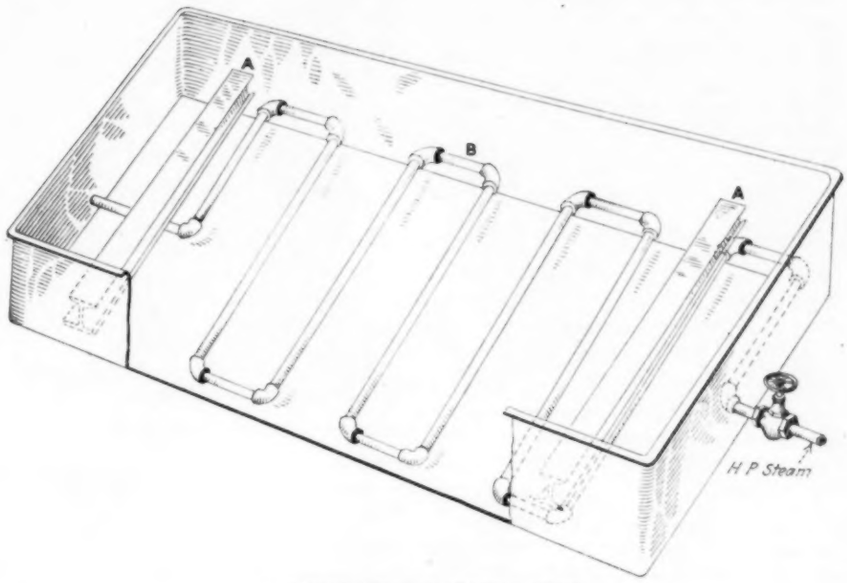
It often happens during tests that it is desirable to use laboratory mercury thermometers in places in the plant where breakage is apt to occur. A thermometer guard, made as shown in the accompanying sketch, is very helpful in such cases. If a man deliberately walks into the guard, the thermometer will break; but the guard is strong enough to resist a great many accidental bumps that it might receive under plant conditions.



Working Drawing of Thermometer Guard

In the sketch, "a" is a piece of standard ¾-inch pipe with a slot milled in two opposite sides. The bushing, "b," is ¾x¾ inches, and "c" is a standard ¾-inch cap. A rubber stopper, shown at "d," of 00 or 000 size is used to make the joint tight.

The pipe has a running thread cut on one end, and the bushing is screwed up far enough to give room for the cap. With the ordinary laboratory thermometer, the space between pipe and thermometer is so small that the combination of cap, stopper, and pipe makes a stuffing box that is satisfactory for moderate pressure. The whole assembly is inserted into the apparatus through a ¾-inch pipe tap and supported by the bushing. A standard ¾-inch cap may have to be trimmed a little in order to insert it into the ¾-inch tapped hole.



Sectional View of Dipping Tank
In this sketch A represents the pipe supports and B the heating coils of 1-inch extra heavy pipe

Applying Protective Coatings to Lapwelded Pipe

By Maurice C. Cockshott
Hollywood, Calif.

The application of a protective coating of an asphaltic base dip to lapwelded, or even cast steel and iron pipe, is the cheapest, and probably most effective method whereby the most service is obtained, and the life of the pipe greatly increased. The following is a brief description of this operation: The pipe must be free from all dirt and rust. If much of the latter is present pipe should be rattled and then carefully brushed off with a stiff steel brush until no rust or scale adheres to the surface. The most convenient way of handling the pipe is by means of a traveling crane which should travel the dipping tank longitudinally. If possible the lifting arrangement should be electrically controlled, in order to facilitate lifting to the drying angle.

The pipe is laid in the tank horizontally, and the dipping compound added. The temperature should not be more than 350 deg. F. and not less than 325. There are various makes of asphaltic base compounds, all probably equally good, as their composition is practically alike and made from the residue of the oil refineries and therefore this description will hold good for any one with such few changes as experience makes desirable. The pipe should remain in the dip until its temperature is the same as the hot liquid—which varies with the amount and weight of pipe, and runs from fifteen minutes to one hour. Small size standard pipe will take from fifteen to twenty minutes, extra heavy flanged pipe of larger diameter, one hour.

Care must be taken that the metal is as hot as possible in order that the dip will enter the pores and make perfect cohesion with the metal which, unless the latter is hot enough, it will not do. In the case of pipe that has riveted connections the liquid will permeate all around and into the small interstices that abound in spite of the best caulking and make a perfectly tight and water-excluding job. After having been in the tank for the necessary time the pipe should be lifted out with small chains and elevated at an angle of 60 deg., until it has thoroughly drained, then removed to the cooling platform.

If a heavier coating is desired, after the pipe has been thoroughly cooled, it is again submerged in the dip for a short period, care being taken that it does not remain in long enough for the pipe to re-heat. The sudden chilling of the dip due to the immersion of the cooled pipe causes another coating to adhere to the original. The thickness, which varies with the time of immersion, and the temperature of the dip, can, with a little practice, be regulated within one-sixteenth of an inch. One thing to watch is that the temperature of the bath must remain constant or a good bonding action will not be obtained.

As the dipping proceeds the dip will lose some of its penetration by the action of the continual heating and a light grade asphalt must be added as a flux (penetration around 100). This will have to be added in from one to three hours, about 30 per cent in quan-

tity, just as more dip is added to original quantity to make up losses.

The best, and safest method of heating as well as perhaps the most economical is by means of steam coils in the bottom of the tank with steam at not less than 140 pounds pressure, as shown in the accompanying sketch. Coils must be set clear of bottom and sides of tank in order to allow for circulation. There should also be a steam trap in the line at the terminal. Should steam not be available and direct fire be resorted to, it must be seen to that the fire does not come into direct contact with the tank. It should be baffled so that the hot gases will pass around the tank in such manner to get all possible heat from them.

Making a Tight Pipe Joint With Lead Filings

A useful method of making leak-proof pipe joints is described in Technical News Bulletin No. 95, recently issued by the Bureau of Standards, Washington, D. C. While this method is not strictly new, but few know of it and the results obtained indicate a decided superiority over usual methods of making up.

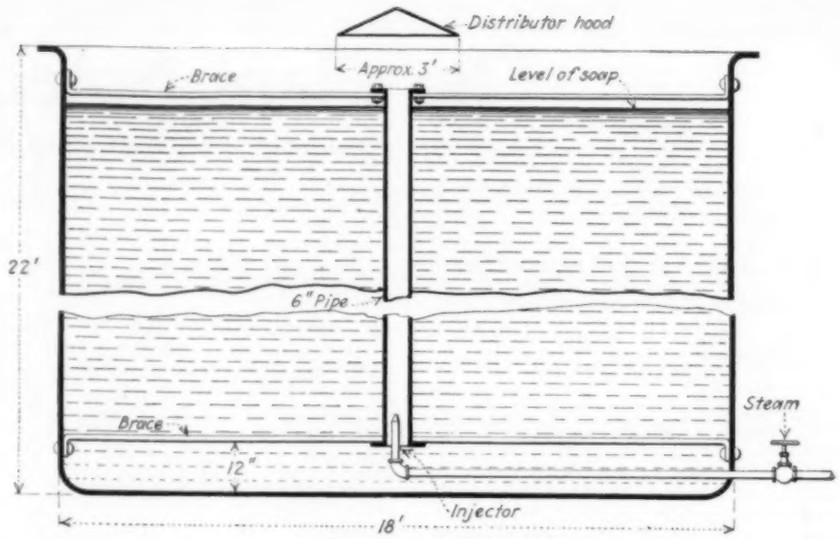
Lead filings, such as are taken from an ordinary lead pipe by a coarse rasp, are sprinkled onto the threads of the pipe joint, being held on while making up the joint by the cutting oil used or by the ordinary white or red lead joint paste. The lead alone, without any paste, is said to be satisfactory and such joints are said not to stick or be difficult to unscrew, as is the case with old joints on which the paste has been used. Also the joint is tighter against leaks.

Tests made on joints with lead filings as described above were conducted at the bureau. These joints were made up with a white lead paste to hold the filings while connections were being made. The joints were allowed to set for a week. Joints made with lead filings alone were also tested. The first failed at 3,900 lb. per sq.in. hydraulic pressure while the joint with lead alone withstood the full pressure of the testing equipment, 8,500 lb. per sq.in. without leaking. After test, the lead joints all unscrewed readily.

Compressed Air to Loosen Contents of Bins

Where such materials as the wood chips in pulp mills are stored in large bins above the apparatus into which they are to be fed, difficulty is sometimes experienced due to the dense packing of the mass. One means of breaking this mass up so that it will feed out through gates or chutes is by the introduction of compressed air.

This air is introduced through a length of small diameter pipe, connected to the compressed air line by a flexible hose. A valve, between the pipe and the hose, serves to regulate the pressure. The free end of the pipe is worked up into the mass that is to be loosened and the compressed air, turned on at the same time, easily frees the material.



Steam Jet Agitator

This method of agitating, used successfully in soap kettles, will find other applications in the agitation of molten gels

Steam Jet Agitator for Thick Liquids

Much difficulty is often encountered in thoroughly agitating liquid gels and similar thick liquids. A soap plant, where this problem was met with, devised the scheme shown in the accompanying sketch, which successfully solved their problem and may be useful to others meeting the same difficulties.

The soap kettles are square tanks, 18 x 18 x 22 feet, heated by steam coils placed in the bottom. In the center of each kettle, braced to the sides, is placed a 6-inch pipe, the bottom flanged end being about one foot off the tank bottom. A steam nozzle is placed in the bottom opening of the 6-inch pipe, pointing upward, and supplied with steam at 5 to 10 lb. pressure. The current set up by this steam, acting as an ejector, pulls the molten soap from the bottom of the kettle, conveys it upward in the pipe and throws it out at the top against a conical shaped distribution hood, so placed that the soap falls over the surface of the soap in the kettle uniformly.

Portable Device for Handling Heavy Machine Parts

A plant having a large installation of Hargreaves-Bird cells from which the plates have to be lifted from time to time, employs a device that should prove of use in many other plants. This device is portable, consisting of an I-beam supported by demountable framework in a position over the cell. The framework is of wood and bolts together. The beam serves as a trolley track for a trolley and triplex-block. By means of this triplex block the plates are lifted from the cells and then moved aside out of the way.

The advantage of such an outfit lies in the fact that it is light, portable and quickly assembled whenever required. Its limits are that it cannot support a very heavy load and that space must be available around the machine for the bases of the supports and for allowing the part removed to be swung out of the way.

An Aid to Continuous Filters Handling Fine Material

Continuous filtration of very finely divided material is sometimes difficult due to the dense character of the cake formed. In the absence of coarse particles it is frequently desirable to resort to auxiliary apparatus to dry the cake to the desired point. A squeeze roll is sometimes employed to press directly on the cake and help put the water through the filter screen. Such treatment, however, results in cracking certain pulps. Where such a situation is encountered, the following method may be found useful.

Above the upper surface of the filter and running parallel to it, a shaft is mounted and to this shaft 2 strips of rawhide about 2 feet wide are attached. The shaft is mounted at a height so that the rawhide strips drag somewhat over the surface of the cake, a piece of canvas being interposed. The shaft is revolved at 10 to 12 r.p.m., while the filter drum revolves about ½ r.p.m. As a result, the flapping rawhide strips, through the canvas, beat and jar the pulp somewhat.

With a vacuum of 22 inches and a cake ¾ inch thick, a product of finely divided calcium carbonate carrying only 23½ per cent of moisture has been made. A dryer, firmer cake may frequently be obtained by this simple and inexpensive auxiliary device.

Making Oily Floors Safe To Work On

An expedient for taking the "slip" out of operating positions that have an oily surface, as at the controls of hydraulic presses turning out cocoa-butter, is to place a piece of light-weight iron grating over a burlap mat. The burlap absorbs the oil, the grating remaining safe to work on.

RIGHT—*The problem of storing pulpwood has been the subject of much study. Various types of log stackers have been developed in consequence. That shown in this view is fed directly from cars on the siding and moves along on rails to the point where the stack is being made.*

Conveyors Give Necessary Aid In Pulp Making

NEWSPRINT plants must move great quantities of pulpwood from the river to storage and to wood grinders and chippers. A steady production of chips must also be moved to the bins over the digesters. The volume thus handled is so great as to preclude the use of hand labor and the pulp maker has thus become a pioneer in the development of material handling equipment. Some of the types used in these plants are shown here.

ABOVE—*Most pulp plants receive their pulpwood by river and the conveyor here shown is one of several types developed for raising this wood from the water and delivering it to storage, chippers or grinders. It consists of 3 parallel chains equipped with dogs at appropriate intervals to keep the logs from sliding back.*

RIGHT—*Chips from the chippers must be moved to the storage bins over the digesters. Chipping is a continuous operation and it has been found best to move this steady flow of material by a troughed belt conveyor like that shown here.*

Equipment News

From Maker and User

Continuous Pressure Filter

A continuous pressure filter of the rotary drum type has been manufactured for some time by the Industrial Separators Co., Inc., 233 Broadway, New York. This filter has been tried out in a number of plants on such materials as dyes and chemicals and the results obtained are said to be highly satisfactory. The makers are now prepared to supply the equipment for all uses where a continuous rotary type filter can be economically and successfully used.

The filter consists of a drum carrying a filter medium and revolving within a casing. Introduction of the liquid to be filtered into the casing and exertion of pressure on the outside of the drum in excess of that on the inside causes the liquid to pass through the filtering medium, the solid material being retained as a cake on the outside of the drum. This cake is removed by a scraper appropriately located. The scraped-off cake is discharged into a conveyor and removed from the filter. By raising or lowering the liquid level and hence regulating the submergence of the drum in the liquid, the ratio of filtering time to drying time may be varied to suit the requirements of any case.

Referring to Figs. 1 and 2, the perforated drum (*1*) revolves within the shell (*2*), containing a liquid at level (*5*). Inside the shell the pressure is maintained at some determined point above atmosphere. The drum is constructed with several hollow sections (*6*) with walls (*1*, *13*, *14* and *15*) as shown. These sections connect with a drain pipe (*7*) controlled by means of a valve (*8*) and used to discharge the filtrate through the central outlet (*9*). Valve (*8A*) and pipe (*7A*) control the flow of vapors injected for "blow-back" to lift the cake from the drum or for cleaning the screen cloth.

The knife scraper (*3*) removes all or part of the cake, according to the regulation. The discharged cake is

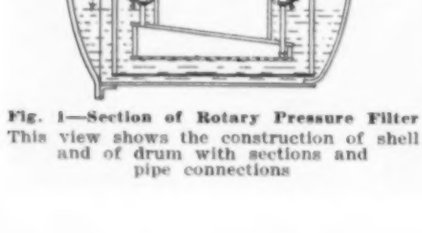


Fig. 1—Section of Rotary Pressure Filter
This view shows the construction of shell and of drum with sections and pipe connections

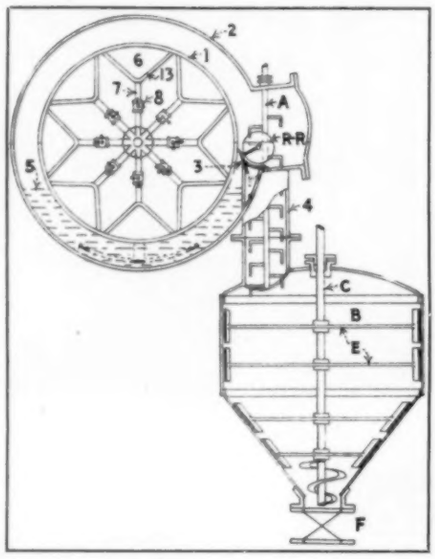


Fig. 2—Cross-Section of Rotary Pressure Filter
This view shows one of the means that are taken for removing the cake from the filter without releasing the pressure in the shell

carried by the conveyor (*R-R*) to the vertical chute (*4*) which is continuously emptied by means of an agitator (*A*). From this chute the cake goes to a receiving hopper (*B*) where it is retained until ultimately released through the gate (*F*). In the hopper is an agitator made up of arms (*E*) on a shaft (*C*), which insures uniformity of cake and positive discharge through (*F*), particularly when the cake is to be resludged or sluiced away upon operating valve (*F*).

When powder-like products are produced the chute and hopper can be eliminated, and a mechanical discharge device is substituted at the end of (*R-R*). Also, in some cases where the product can be sluiced away, the liquid for this purpose can be introduced directly into the conveyor trough and discharge effected through a throttle valve or nozzle or into a second filter stage. In general, discharge methods can be suitably developed to fit the needs of any manufacturing process to which the filter is applied.

This type of filter, besides having the same continuous feature so popular in the rotary vacuum filter, is said to give a capacity that is much greater and, in almost all cases to require a much smaller investment per unit of capacity. In addition, it is useful as a vacuum filter when handling material that volatilizes during filtering, for the enclosing shell prevents loss of vapor, the vacuum drawing the vapors away. This saves material and also, in case the vapors are explosive, reduces hazards.

Determination of Consistence

By W. R. Goddard and C. K. Hewes
General Petroleum Corp.,
Los Angeles, Calif.

Determination of consistence involves consideration of at least two factors—yield point and mobility. Yield point has been defined as "the shearing force which must be applied to a plastic solid before any flow begins," and mobility as "the ratio between flow and shearing force above that required to start flow." Two other factors, elasticity and texture, also may be considered, to differentiate between cup grease and sponge grease, for example. For a given grade of grease, however, it is only necessary to obtain an indication of yield point and mobility, because elasticity is almost negligible and texture is smooth. As the yield point and mobility vary indirectly, it seems possible to measure flow produced by a given force. Such a measurement has been found to permit a differentiation between greases of similar type.

When we undertook the measurement of the consistence of greases no satisfactory instrument was available. Our object was to develop an apparatus that was simple in design and operation, that gave reproducible results, and that furnished all readings on a single scale. Furthermore, a determination of elasticity was found desirable for certain greases. The G-H consistence tester, as it is called, has been found entirely satisfactory in these respects over a considerable period of time and with a wide variety of materials. The apparatus determines, by direct reading, the consistence of a substance by recording the depth in millimeters to which a standardize penetrator needle sinks when allowed to fall through a definite distance. Consistence varies with

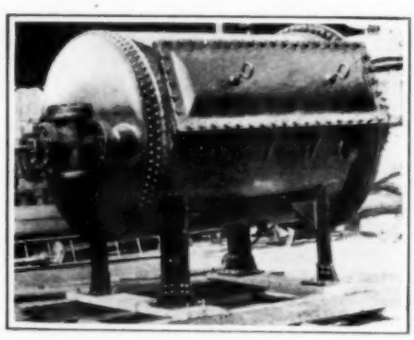
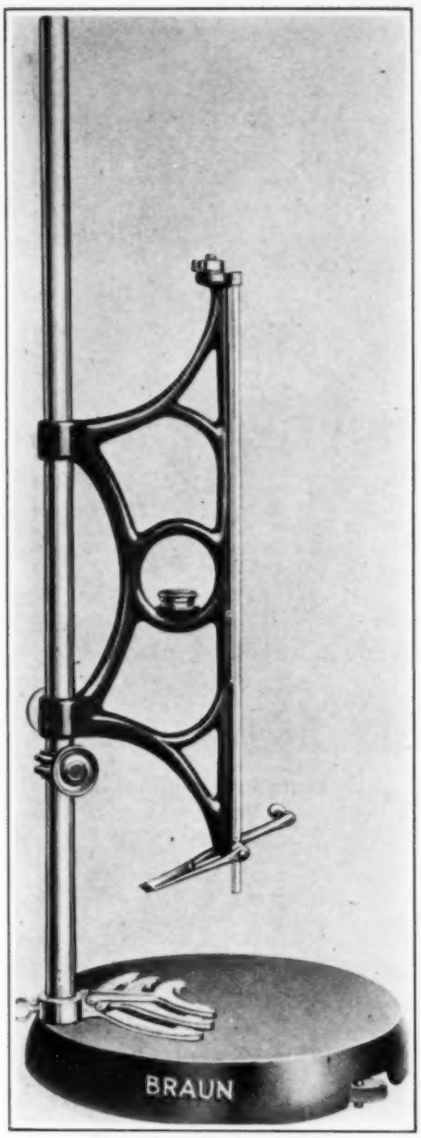


Fig. 3—Continuous Rotary Pressure Filter
This view of an unerected unit shows clearly the type of construction employed. This unit is 4 ft. in diameter by 6 ft. long. Any size up to 8 ft. diameter by 10 ft. face can be furnished



G-H Consistence Tester

temperature, which must be carefully noted, or the substance brought to some desired temperature before testing. After leveling the apparatus, the sample, having been brought to the desired temperature in any convenient container, is placed on the base. The guide support is then lowered until the top of the sample may be scraped to a smooth and even surface, thereby insuring a uniform distance between the surface of the sample and the point of support of the penetrator needle, which is then placed in position and allowed to fall, by pressing the button on the top of the mechanism. The consistence is read by observing on the scale the distance to which the top of the penetrator wire sinks below the zero point. Elasticity in the more plastic substances is shown by the number of millimeters the penetrator needle rises from the lowest depth reached on falling. The test is completed in a few moments and without the aid of outside apparatus such as stop watches or measuring devices. The personal element is almost eliminated and reproducible results on a homogeneous sample can be obtained in a series of tests.

The apparatus can be used to test substances with a wide range of consistence, from a soft grease to a hard, compressed soap. Even with a substance so soft that it will not hold the weight of the penetrator needle, it is often found possible to obtain a definite reading on the scale before the needle sinks slowly in consequence of its own weight.

The consistences of many commercial products are important factors in their use. The following are examples: Greases, face creams, pomades and pastes of all kinds, putty, soap, semi-solid vegetable and animal oils, printer's ink paste, doughs, food products such as oleomargerine, peanut butter and jellies, and dental impression waxes. The effect of temperature on consistence is easily and quantitatively determined by the apparatus described. By interpreting consistence as the depth in millimeters penetrated by the needle under the conditions of test outlined, with temperature at 77 deg. F., the following results will serve to indicate the range of application of the apparatus: Cup grease, No. 0, 113; cup grease No. 1, 75; cup grease No. 2, 60; cup grease No. 3, 43; cup grease No. 4, 35; cup grease No. 5, 30; railroad driving journal grease, 10; railroad rod cup grease, 9; Ivory soap, cake, 8.

Standard specifications to cover the grading of greases according to consistence are commonly given in terms of soap content, but it is our experience that other factors are of influence. Hence, a new interpretation of consistence is desirable, based on a quantitative measure of this property. We have tested several greases, made by the same company, the grade numbers and consistences of which did not follow in proper sequence.

The G-H consistence tester has been found useful in the control of grease manufacture. Samples may be taken from the kettle, cooled, the consistence determined and changes made, if necessary, before the grease is drawn into the containers.

Ball Bearing Chain Block

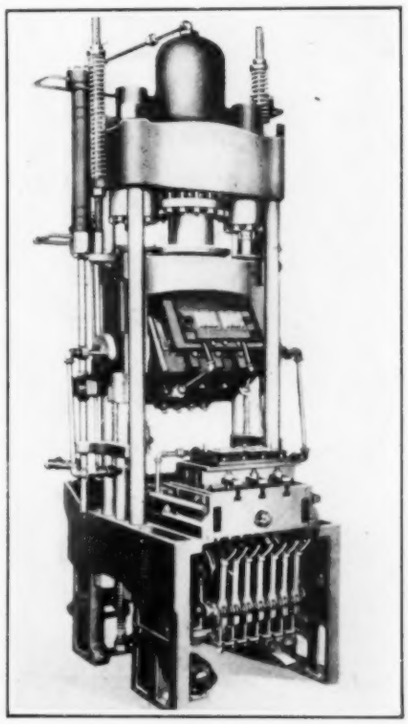
Ball bearings have been applied to chain block hoists in the latest design brought out by the Yale & Towne Mfg. Co., Stamford, Conn. These ball bearings are of vanadium steel and are applied to the load sheave as shown in the accompanying photograph. As placed these bearings take the entire weight of the load and all sudden overloads that may occur through careless handling, such as allowing the load to swing off a platform, or drop suddenly from a height, etc.

It is claimed that, by the introduction of these ball bearings, the amount of pull on the hand chain necessary to lift a given load has been materially reduced, due to the lessening of friction. They are also said to add much to the life of the hoist and to increase the mechanical efficiency over six per cent. The balls are retained by steel and felt dust proof washers and continuous lubrication is provided for. Sizes of ball bearing chain blocks range from ¼ to 20 tons.

Load Sheave of Ball Bearing Chain Block
This sectional view shows the method by which the bearings are applied to the sheave.

Plastic Press

With the large increase in the use of molded plastics, such as phenolic condensation products, pyroxylin compounds, etc., machines especially designed for working these materials are being placed on the market. One of the most recent of these is a molding

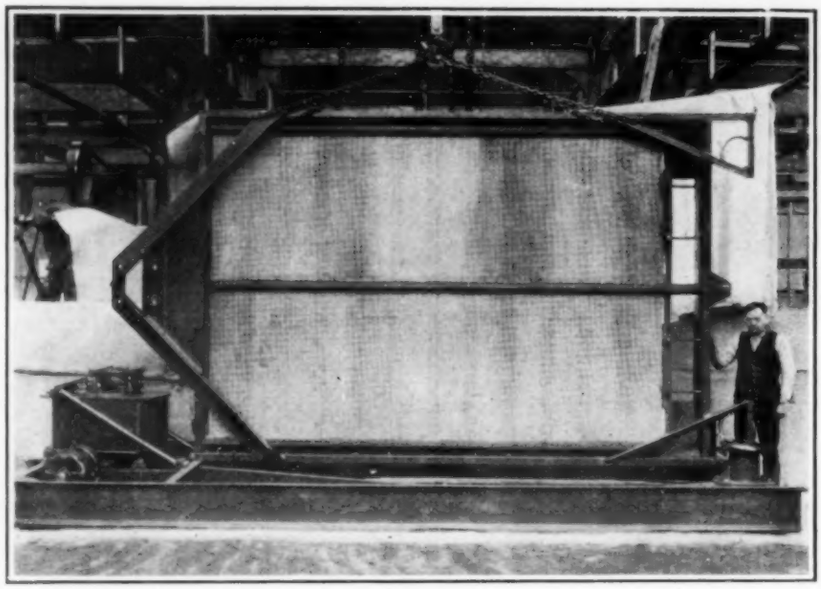


Automatic Universal Hydraulic Molding Press for Plastics

press for quantity production, made by the Hydraulic Press Mfg. Co., Mount Gilead, Ohio.

This press is said to make production possible at a low cost because it requires but little attention from the operator, has little lost time between operations and eliminates defective molded parts. Every part of the operating cycle is under full automatic control, the multiple unit motor-driven control valve being adaptable to almost any time cycle and sequence of operations that might be desired. The ejecting mechanism is automatic and operates at the same time in both the revolving head and the sliding table. The motor automatically stops at the end of each cycle, so that the operator can safely remove the finished parts, clean the dies, place new inserts and reload with raw compound. Operation is started again by throwing a lever.

When resetting the press for a new operation or at any other time that it is desired to control any particular part or parts of the operating cycle independently, the cam shaft on the control valve may be thrown out of gear and hand control used.



The "Rotex-Jumbo" Gyratory Screen
This new model of a well known screen has a greatly increased capacity and a range from ¾-inch opening to the finest screen cloth.

Centrifugal Pump

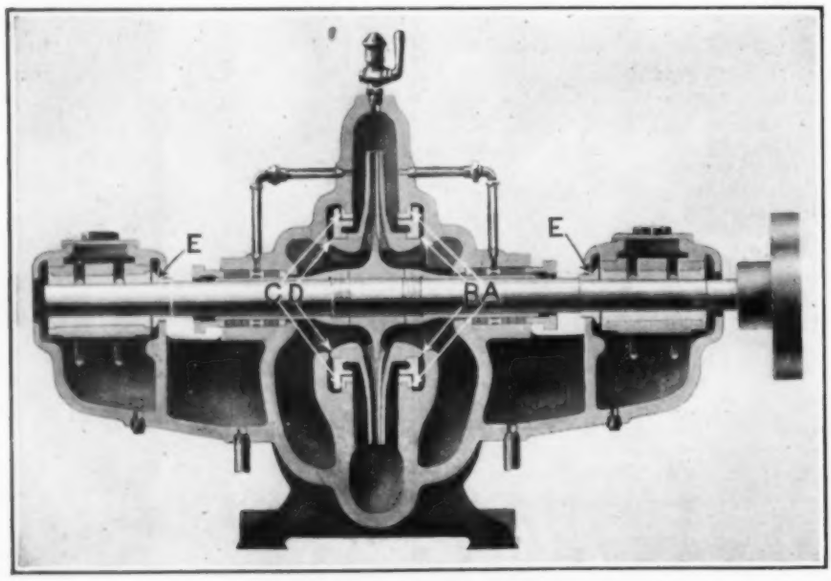
A new line of double suction centrifugal pumps has recently been placed on the market by The Earle Gear & Machine Co., Philadelphia, Pa. These pumps are claimed to embody a very effective means of neutralizing end thrust. This pump is called the Type "B" DSV pump.

Referring to the accompanying sectional view of the new pump, if the thrust were toward the reader's right, the radial seat "B" will tend to close, while the radial seat "A" is opened, building up a pressure on the total area of the right side of the impeller. While this is occurring, the radial seat at "C" has closed, and the radial seat at "D" has opened, placing a suction, or reduced pressure on the area of the side of the impeller from "C" to the shaft.

Hence, the area on the right side of the impeller, subject to high pressure, is greater than the area of the left side of the impeller, subject to same pressure, and also since a suction or lower pressure is exerted against that portion of the left side of the impeller from "C" to the shaft, the pump rotor will tend to move slightly to the left until it reaches a point at which the total pressure will be the same on both sides of the impeller, and true hydraulic balance is obtained. The opposite cycle of events takes place if the original thrust tends to be towards the reader's left.

Due to this hydraulic balance, no thrust bearing or collars are required, but since any device must ultimately wear out, and being inside the case where wear is not visible, small fixed collars "E" are placed on the shaft, set at a distance from the face of the bearing bushing, which will not become operative until the limit of allowable wear has occurred within the case, at which time the engagement of the collars and bearings becomes a visible indication of the need of replacement of wearing parts within the pump.

These pumps are also designed so that high efficiency and long life will result. Split babbitted bearing shells are provided, with two oil rings. Bronze sleeves are provided to protect the forged steel shaft from the action of the liquid handled; deep stuffing boxes with a brass stuffing box bottom, ring, and brass water seal rings are incorporated in their design, and provisions are taken to keep the oil from splashing out of and water from entering into the bearings. Provisions are also made to minimize the air pockets in the pump casing, and to keep the water from rotating with the impeller in the suction passages, thereby increasing the efficiency.



Double Suction Volute Pump
This pump is designed to automatically eliminate end thrust that might occur from slight unbalance of parts.

Large Capacity Screen

The manufacturers of the well-known "Rotex" screen, The Orville Simpson Co., Cincinnati, Ohio, are placing on the market a new screen called the "Rotex - Jumbo" screen. The new model is of much greater capacity than those made in the past, having 2 screening surfaces side by side, each 4 by 12 ft. This allows those desiring greater capacity than is obtainable from the older design to obtain it from a single unit of the new model. For instance, in screening crushed limestone that has previously passed a ¾-inch mesh on 4 mesh screen cloth, the "Jumbo" will receive a total of 72-tons feed per hour. The features of gyratory movement and ball and wedge mesh cleaning that characterized the older designs, are present in the new screen. The accompanying photograph shows one of the new screens held on its side by a hoist, so that the size of screening surface is evident.

Patents Issued Feb. 17 to March 24, 1925

Paper, Pulp and Sugar

Paper Making. Lester Kirschbraun, Chicago, Ill., and Thomas W. Morse, Ridgefield Park, N. J., said Morse assignor to Flintkote Co.—1,526,553.

Pulp-Bleaching Apparatus. Jalmar E. Heiskanen, Enso, Finland, assignor to Stebbins Engineering and Manufacturing Co., Watertown, N. Y.—1,530,494.

Pulp-Bleaching Method and Apparatus. August F. Richter, Watertown, N. Y., assignor to Stebbins Engineering and Manufacturing Co., Watertown, N. Y.—1,529,919.

Refiner for Pulp, Sawdust, and the Like. Hervey G. Cram, Newport, Me., assignor to Great Northern Paper Co., Millinocket, Me.—1,526,461.

Paper Making. Lester Kirschbraun, Chicago, Ill.—1,526,552.

Process of Manufacturing Pure Cellulose from Wood. James M. Leaver and Elie S. Humboldt, Oakland, Calif., assignors to The Pacific Lumber Co., San Francisco, Calif.—1,528,218.

Paper Made From Lanella Fiber. August Lendle, Forest Hills, N. Y., assignor to Kuttroff Pickhardt & Co., Inc., New York, N. Y.—1,528,440.

Process For Treating Wood. George E. Rice, Brooklyn, N. Y., assignor to Su-Dex Wood Curing Co., Inc., Coscob, Conn.—1,527,330.

Recovery of Sirup from Waste sugar Products. Ernest J. Collings, Bridgeport, Conn., and Argimiro Morales, New York, N. Y., assignors to New Jersey Sugar Products Corporation, Matawan, N. J.—1,530,594.

Decolorizing and Purifying Sugar and other Crystalline or Granular Substances. Donald Grant, Litherland, England, assignor to Klarit Limited, Litherland, Liverpool, England.—1,530,823.

Process of Manufacturing Sugar. Edwin Morrison, Denver, Colo., assignor to The Great Western Sugar Co., Denver, Colo.—1,528,501.

Synthetic Plastics and Rubber

Manufacture of Plastic Materials or Articles Having a Basis of Cellulose Acetate. Henry Dreyfus, London, England.—1,528,291.

Leather Substitute and Like Composition. Gustav Adolph Ampt., Melbourne, Victoria, Australia, assignor of one-half to Samuel Charles Lansdown, North Fitzroy, Victoria, Australia.—1,527,163.

Article Surfaced with Nitrocellulose and Synthetic-Resin Coatings and Process of Making Same. Carleton Ellis, Montclair, N. J.—1,529,056.

Phenolic Resin Varnish. Harold C. Cheetham, Chicago, Ill., assignor to Bakelite Corp., New York, N. Y.—1,528,006.

Apparatus Useful in Making Plastic Shapes. Charles L. Norton, Boston, Mass., assignor to Refractories Machinery Manufacturing Company, Pittsburgh, Pa.—1,526,364.

Plastics Containing Cellulose Acetate. Henry Dreyfus, London, England.—1,530,987.

Manufacture of Cellulose Acetates and the Like. Joe Olgierd Zdanowich, London, England.—1,528,810.

Process of Making a Rubberized Fiber Composition. William G. O'Brien, Akron, Ohio, assignor to The Goodyear Tire & Rubber Co., Akron, O.—1,529,207.

Method of and Means for Producing Metallized Surfaces on Rubber Compounds Containing Sulphur. Albert Ivan Gates Warren, Caterham Valley, Surrey, England, assignor to Caterham Works Limited, London, England.—1,527,241.

Process for Obtaining Rubber-Containing or Similar Materials. Ernest Hopkinson, New York, N. Y.—1,526,984.

Manufacture of Rubber. Philip Schidrowitz and Mervyn Stanley Stutchbury, London, England.—1,530,164.

Petroleum Refining

Method of Treating Hydrocarbon Oils. Henry Clay Wade, New York, N. Y.—1,530,587.

Method of Distilling Vapors from a Solid Absorbent Medium. Clyde L. Voress, Ridgefield Park, N. J., and Vernon C. Canter, Bradford, Pa., assignors to Gasoline Recovery Corp.—1,528,459.

Process for Manufacturing Aluminum Compounds. Edson R. Wolcott, Los Angeles, Calif., assignor, by mesne assignments, to The Texas Co., New York, N. Y.—1,528,039.

Method of Revivifying Spent Carbonaceous Materials. John C. Woodruff, Larchmont, N. Y.—1,528,905.

Method of Purification of Filtering Agent. Percy A. Boeck and Harry S. Thatcher, Los Angeles, Calif., assignors, by mesne assignments, to The Celite Co.—1,526,520.

Gauge Mounting for Stills. Otto Behimer, Port Arthur, Tex., assignor to The Texas Co., New York, N. Y.—1,526,312.

Method of Decomposing Hydrocarbons. Charles F. Crommett, Chelsea, Mass., assignor of one-third to Wilfred J. Hawkins, New York, N. Y., and one-third to Louis N. Wheelock, Boston, Mass.—1,528,099.

Method of Making Decolorizing Carbons. Christian J. Gambel, New Orleans, La.—1,528,371.

Process and Apparatus for Refining Petroleum Oil and Its Distillates. John Hancock, Webster Groves, Mo.; Myrtle C. Hancock, administratrix of said John Hancock, deceased.—1,528,327.

Process of Making Absorbent Carbon. Jacque C. Morrell, Oak Park, Ill.—1,530,393.

Process for the Manufacture of Decolorizing Charcoal of High Activity. Rudolf Adler, Carlsbad, Czechoslovakia.—1,530,536.

Process of Making Gasoline From Crude Mineral Oil. Wilfred Fourness, Pasadena, Calif., assignor of two-thirds to S. Hazard Halsted, Ezra S. Gosney, and Guy R. McComb, all of Pasadena, Calif.—1,526,907.

Method and Apparatus for Cracking and Distilling Oils. Charles F. Richey and Paul Y. Duffee, Franklin, Pa.—1,530,091.

Oil Still. George J. Burns, Youngstown, O.—1,527,836.

Petroleum Still. William D. P. Aims, Philadelphia, Pa.—1,528,520.

Still. Robert H. Lindsay, Houston, Tex.—1,529,030.

Process for Cracking Oil. Carey W. Thompson and Henry C. Beeler, Denver, Colo.—1,530,627.

Method of Distilling Volatile Liquids. John Henry Wiggins, Bartlesville, Okla.—1,527,944.

Oil Still. Philip Heffler, Pittsburgh, Pa., assignor of one-half to Harry C. Simmons, Crafton, Pa.—1,527,871.

Refining of Cracked Gasoline. Benjamin T. Brooks, Sound Beach, Conn., and Harrison O. Parker, Howard Beach, N. Y., assignors to The Mathieson Alkali Works, Inc., New York, N. Y.—1,528,398.

Apparatus for Refining Oil. William J. Reilly, Denver, Colo.—1,529,504.

Apparatus for Treating Petroleum. Walter A. Brown, Los Angeles, Calif.—1,528,968.

Art of Petroleum Distillation. Thomas S. Cooke, Whiting, Ind., assignor to Standard Oil Co., Chicago, Ill.—1,526,834.

Process of Purification of Hydrocarbons. Lazar Edeleanu, Charlottenburg, and Wilhelm Hess, Lichterfelde, Germany.—1,526,665.

Process and Apparatus for Refining Oils. Raymond Auguste Dornes, New York, N. Y., assignor to Dorwin Manufacturing Co., Phoenix, Ariz.—1,526,534.

Process of Manufacturing a New Composition from Mineral Oil. Harold T. Maitland, Sharon Hill, Pa., assignor to Sun Oil Co., Philadelphia, Pa.—1,528,884.

Method of Manufacturing a Highly-Active Adsorption Carbon. Erwin Schmidt, Mannheim-Waldhof, Germany, assignor to Gesellschaft fur Chemische Produktion m.b.H., Mannheim-Waldhof, Germany.—1,527,083.

Process for the Prevention of Petroleum Emulsions in the Well. John D. Brady, Bartlesville, Okla.—1,531,173.

Process for Treatment of Oil Emulsions. William O. Eddy, Long Beach, Calif.—1,529,349.

Process of Producing Emulsions. Walter Grant Dixon, West Chester, Pa., assignor to Sharples Separator Co., West Chester, Pa.—1,526,465.

Apparatus for Separating Oil from Oil-Bearing Sands and Rocks. William J. Reilly, Denver, Colo.

Wax Eliminator. Charles G. Stowell and Robert F. Simme, Duluth, Minn.—1,526,615.

Art of Filtration. Edgar M. Clark, New York, N. Y., and Frank A. Howard, Elizabeth, N. J., assignors to Standard Development Co.—1,528,427.

Oil and Gas Separator. Albert M. Ballard, Yale, Okla., assignor to Sun Oil Co., Philadelphia, Pa.—1,530,879.

Process of Making Grease. James McKee, Chester, and Samuel B. Eckert, Devon, Pa., assignors to Sun Oil Co., Philadelphia, Pa.—1,530,386.

Device for Heating Oil and Other Viscous Liquids. Wilhelm Riehm, Augsbury, Germany.—1,527,273.

Heat-Exchanging Apparatus. Percy Mather, London, England.—1,526,605.

Heat Exchanger. William H. Cook, Urbana, O., assignor to Chauncey B. Forward, Urbana, O.—1,526,320.

Heat-Exchange Apparatus. James H. Harrison, Cleveland, O.—1,530,559.

Combustion, Fuels and Refractories

Liquid-Fuel-Burning Apparatus. John A. H. Hood, New York, N. Y., assignor to Todd Oil Burner and Engineering Corporation, New York, N. Y.—1,530,079.

Fuel-Oil-Burning Apparatus John Beattie, Jr., Fall River, Mass.—1,529,153.

Liquid-Fuel Burner. Albert W. Morse, Long Island City, N. Y.—1,526,429.

Oil-Burning Apparatus. Ernest H. Peabody, Pelham Manor, N. Y.—1,527,214.

Oil Burner. Arthur H. Ballard, Boston, Mass.—1,530,473.

Method of and Means for Burning Pulverulent Fuels. Charles W. Lotz, Pottsville, Pa.—1,531,255.

Blower. Frans H. C. Coppus, Worcester, Mass., assignor to Coppus Engineering Corporation, Worcester, Mass.—1,530,982.

Coke-Oven Construction. Joseph Geiger, Steelton, Pa.—1,530,995.

Coking Retort Oven. Joseph Van Ackeren, Pittsburgh, Pa., assignor to The Koppers Co., Pittsburgh, Pa.—1,530,631.

Distillation of Fuels. Norman James Bowater, London, England.—1,528,600.

Manufacture of Gas. John Lester Murrie, Yonkers, N. Y.—1,530,281.

Tubular Gas Producer. Jules Babin, Paris, France.—1,530,709.

Gaseous Fuel. John Harris, Cleveland, O., assignor to James R. Rose, Edgeworth, Pa.—1,528,765.

Vertical Retort Battery. Joseph Van Ackeren, Pittsburgh, Pa., assignor to The Koppers Co., Pittsburgh, Pa.—1,528,228.

Coke Oven. Louis Wilputte, New Rochelle, N. Y., assignor of two-third to Alice A. Wilputte, New Rochelle, N. Y.—1,528,808.

Apparatus for the Carbonization of Coal and the Like. Harold Pearson Hird, Dewsbury, England.—1,530,896.

Interlocking Control System for Apparatus Valves of Water-Gas Sets. Fred B. Hayes, Fort Wayne, Ind., assignor to The Western Gas Construction Co., Fort Wayne, Ind.—1,526,475.

Storing Acetylene Gas. Charles Picard, Champigny-sur-Marne, France, assignor to Societe l'Air Liquide, Societe Anonyme pour l'Etude et l'Exploitation des Procedes Georges Claude, Paris, France.—1,526,562.

Machine for the Manufacture of Fuel Briquettes from Peat. John Campbell, Detroit, Mich.—1,526,360.

Tunnel Furnace. Charles M. Stein, Paris, France, assignor to Societe Anonyme des Appareils de Manutention et Fours Stein, Paris, France.—1,529,755.

Acetylene Generator. Alexander F. Jenkins, Baltimore, Md.—1,531,187.

Refractory Product and Method of Producing Same. Harrison P. Hood, Corning, N. Y., assignor to Corning Glass Works, Corning, N. Y.—1,527,874.

Manufacture of Silicon-Carbide Refractories. Samuel F. Walton, Boston, Mass., assignor, by mesne assignments, to International Coal Products Corporation.—1,528,352.

Basic Refractory Material and Method of Making the Same. Arthur Lee Browne, Baltimore, Md., assignor to The Standard Lime & Stone Co., Baltimore, Md.—1,527,347.

Vitreous Material. Vitreous Material. Frederick G. Keyes, Cambridge, and Charles A. Kraus, Worcester, Mass., assignors to Arthur A. Noyes, trustee, Pasadena, Calif.—1,526,423.

Process of Forming Ceramic Products. Albert V. Bleininger, Newell, W. Va., assignor of one-half to Frank H. Riddle, Detroit, Mich.—1,528,908.

Inorganic Processes

Manufacture of Aluminum Hydroxide. Georg Muth, Nuremberg, Germany, assignor to The Amber Size and Chemical Co., Ltd., London, England.—1,527,903.

Process for Purification of Aluminum Salts. Oliver C. Ralston and George S. Tilley, Berkeley, Calif.—1,529,035.

Aluminous Abrasive Material and Method of Making the Same. Frank J. Tone, Niagara Falls, N. Y., assignor to The Carborundum Co., Niagara Falls, N. Y.—1,528,639.

Process of Making Crystalline Mineral Particles. Miner L. Hartmann, Niagara Falls, N. Y., assignor to The Carborundum Company, Niagara Falls, N. Y.—1,528,543.

Process for the Production of Soluble Barium Salts. Anton Jahl, Hamburg, Germany, assignor to J. Michael & Co., Berlin, Germany.—1,529,435.

Process of Making Chromates. George P. Fuller, La Salle, N. Y., assignor, by mesne assignments, to Edward Michael, Buffalo, N. Y.—1,531,088.

Manufacture of Chromates. Louis Charles Drefahl, Lakewood, O., assignor to The Grasselli Chemical Co., Cleveland, O. —1,526,325.

Process of Making Arsenate of Lead. Henry Howard, Cleveland, O., assignor to The Grasselli Chemical Co., Cleveland, O.—1,529,998.

Insecticide. Harry C. Bickmore, Atlanta, Ga.—1,527,246.

Art of Manufacturing Zirconium Compounds. Lonnie W. Ryan, Chicago, Ill., assignor to Lindsay Light Co., Chicago, Ill. —1,530,139.

Process of Making Zirconium Oxide. Hugh S. Cooper, Cleveland, O., assignor to Kemet Laboratories Co., Inc.—1,527,470.

Process for the Preparation of Oxygenated Compounds of Titanium and Pigments Containing Said Compounds. Georges Carteret, Boulogne, and Maurice Devaux, Paris, France.—1,528,319.

Production of Pigment Colors. Carl Immerheiser and Bodo Zschimmer, Ludwigshafen-on-the-Rhine, Germany, assignors to Badische Anilin- & Soda-Fabrik, Ludwigshafen-on-the-Rhine, Germany.—1,529,891.

Process in the Roasting, Calcining, Decarbonization, and Desulphurization of Carbonates, Sulphide Ores, and other Materials, and Apparatus Therefor. William Lanyon, St. Louis, Mo.—1,528,155.

Process for the Production of Hydrogen. John Collins Clancy, Providence, R. I., assignor to the Nitrogen Corporation, Providence, R. I.—1,526,529.

Recovery of Ammonium Chloride. William H. Dahmen, Yardley, Pa.—1,527,027.

Recovery of Silver from Solutions Used in Photographic Work and Regeneration of Such Solutions for Further Use. Louis Weisberg, New York, N. Y.—1,527,942.

Process of Recovering Helium. James A. Rafferty, Rye, N. Y., and Harold E. Thompson, Clendenin, W. Va., assignors to Carbide and Carbon Chemicals Corp. — 1,529,625.

Dyes and Organic Processes

Azo Dyestuffs and Process of Making Same. August Heinrich Schobel, Basel, Switzerland, assignor to Society of Chemical Industry in Basle, Basel, Switzerland.—1,529,927.

Vat Dyestuffs and Process of Making the Same by Condensing Thioderivatives of Benzoquinones with Arylamines. Richard Herz, Frankfort-on-the-Main, Germany, assignor to Leopold Cassella & Co., Gesellschaft mit beschrankter Haftung. — 1,530,670.

Production of Nitrogen Containing Anthraquinone Bodies. Hugh Albert Edward Drescher and John Thomas, Carlisle, England, assignors to Scottish Dyes, Ltd., Carlisle, Cumberland, England.—1,528,470.

Anthraquinone Derivative and Process of Making the Same. Bertram Mayer, Basel, and Jakob Wurgler, Neuewelt, near Basel, Switzerland, assignors to the Society of Chemical Industry in Basle, Basel, Switzerland.—1,527,894.

Production of Coloring Matters. Arthur Hugh Davies, deceased, late of Willenhall, England; by Mary Olivia Davies, administratrix, Willenhall, England, and Robert Fraser Thomson and John Thomas, Carlisle, England, assignors to Scottish Dyes, Limited, Carlisle, England.—1,531,260.

Preparation of Alkyl Esters of Amino-Benzoic Acids. Charles W. Hooper, Jamaica, N. Y., assignor to H. A. Metz Laboratories, Inc., New York, N. Y.—1,530,121.

Hydrolysis of Sulphuryl Chloride. Ralph H. McKee, New York, N. Y.—1,528,255.

Process for Producing Lampblack. Carl Fischer, West Homestead, Pa.—1,528,324.

Production of Hydrocyanic Acid. John E. Bucher, New York, N. Y., assignor to Nitrogen Products Co., Providence, R. I.—1,526,525.

Manufacture of Alkali Metal Cyanide. Alwin Mittasch and Wilhelm Michael, Ludwigshafen-on-the-Rhine, Germany, assignors to Badische Anilin- & Soda-Fabrik, Ludwigshafen - on - the - Rhine, Germany. — 1,531,123.

Process for Production of Nitrogen Compounds by Absorption of Nitrogen in a Mixture of Reaction. Otto Troell, Hokopinge, Sweden.—1,526,398.

Method of Granulating Lime Nitrogen. Salomon Ejnar Rodling and Adolf Paulinus Zamore, Ljunga Verk, Sweden, assignors to Stockholms Superfosfat Fabriks Aktiebolag, Stockholm, Sweden.—1,528,851.

Process for the Preparation of Fatty Acids of the Acetic-Acid Series from their Higher Homologues. Harry E. Dubin and Louis Freedman, New York, N. Y., assignors to Herman A. Metz, New York, N. Y.—1,529,946.

Process of Preparing Light, Readily-Liquefied Hydrocarbons from Ethylene and Gases Containing the Same. Alexander S. Ramage, Detroit, Mich., assigner to International Color and Chemical Co., Incorporated, Detroit, Mich.—1,527,079.

Process for Disintegrating or Decomposing Coal Tar or its Distillates into Phenols and Neutral Oils. Anton Weindel, Essen-Ruhr, Germany, assignor to Zeche Mathias Stinnes, Essen-Ruhr, Germany.—1,528,313.

Electrolytic Cells and Processes

Storage Battery. Thomas A. Edison, West Orange, N. J.—1,526,326.

Electric Battery. Paul E. Norris, Wilkinsburg, Pa., assignor to Westinghouse Union Battery Co., Swissvale, Pa. — 1,526,865.

Bifunctional Storage Battery. John W. Fraser, Cleveland, O.—1,526,539.

Storage Battery. James M. Allen, St. Louis, Mo., assignor to James M. Allen, Fred P. Smith, and Frederick D. Tucker, trustees.—1,526,453.

Electric Battery. Raymond C. Benner, Fremont, Ohio, assignor to National Carbon Co., Inc.—1,526,823.

Dry Battery. Donald W. Tyrrell, Madison, Wis., assignor to French Battery & Carbon Co., Madison, Wis.—1,528,091.

Method of Manufacturing Dry Cells. Victor Yngve, South Orange, N. J., and Charles G. Birdsall, Elmhurst, N. Y., assignors to Manhattan Electrical Supply Co., Incorporated, New York, N. Y. — 1,526,620.

Dry Battery Cell. Harry M. Koretzky, New York, N. Y.—1,526,424.

Recovery and Utilization of Materials of Old Secondary Battery Plates. Joseph O. Luthy, San Antonio, Tex., assignor to Luthy Battery Equipment Company. — 1,526,714.

Process of Electroplating and Apparatus Therefor. George H. Pinney, South Manchester, Conn., assignor to the Williams Brothers Manufacturing Company, Glastonbury, Conn.—1,526,644.

Process for Obtaining Alkali Metals. Louis Hackspill and Charles Staehling, Strassburg, France.—1,528,824.

Chemical Engineering Equipment

Apparatus for Treating Liquids with Gases. William E. Greenawalt, Denver, Colo.—1,526,596.

Absorption Apparatus. Frank E. Lichtenthaeler, Newton Highlands, Mass.—1,531,112.

Apparatus for the Absorption of Gases in Liquids. Henry Howard, Cleveland, Ohio, assignor to the Grasselli Chemical Co., Cleveland, O.—1,529,997.

Process of and Apparatus for Speeding and Aiding the Absorption or Evolution of Gases. Herman B. Kipper, Muskegon, Mich.—1,530,949.

Carbonator. Henry Joseph Irmin, Jersey City, N. J.—1,526,477.

Ammonia Absorption Refrigeration Method and Apparatus. Jules Buchel, New Orleans, La.—1,527,833.

Method and Apparatus for Treating Clay Ware in Tunnel Kilns. Carl B. Harrop, Columbus, O.—1,531,181.

Kiln. Donald R. Brewster, Cincinnati, O., assignor to the Standard Dry Kiln Co., Indianapolis, Ind.—1,527,955.

Enameling Furnace. Herbert Charles Beasley, Chicago, Ill., assignor to Coonley Manufacturing Company, Chicago, Ill.—1,526,582.

Tunnel Oven for Burning Ceramics and the Like. Heinrich Koppers, Essen-Ruhr, Germany, assignor to the Koppers Development Corp., Pittsburgh, Pa.—1,527,982.

Oven for Burning Refractories and the Like. Heinrich Koppers, Essen-Ruhr, Germany, assignor to the Koppers Development Corp., Pittsburgh, Pa.—1,528,555.

Drier. Julius Judelson, New York, N. Y., assignor to Judelson Evapo-Dryer Corp.—1,527,192.

Dehydrator. Edwin D. Valliant, San Martin, Calif.—1,527,020.

Evaporator. Joseph Schneible, Chicago, Ill., Beatrice Schneible Ingram, administratrix of said Joseph Schneible, deceased.—1,530,140.

Apparatus and Process for Fractionating Air. Gorton R. Fonda, Schenectady, N. Y., assignor to General Electric Company.—1,527,639.

Reflux Condenser. Daniel H. Christman, Shreveport, La., assignor to Christman Process, Inc.—1,526,902.

Process for Continuous Rectification of Liquid Air or other Liquefied Gases. Emile Augustin Barbet, Paris, France.—1,529,233.

Condenser for Refrigerating Systems. Eastman A. Burrows, Chicago, Ill.—1,526,961.

Apparatus for the Condensation of Volatile Metals such as Zinc and the Like. Fritz Caspari, Gelsenkirchen, Germany.—1,530,154.

Apparatus for Deaeration of Liquids. Selden H. Hall, Poughkeepsie, N. Y., assignor to the De Laval Separator Co., New York, N. Y.—1,529,884.

Method and Apparatus for Deaerating Water. George Herbert Gibson, Montclair, N. J., assignor to Cochrane Corporation, Philadelphia, Pa.—1,530,598.

Apparatus for Removing the Oxygen Content from Atmospheric Air. Edward E. Arnold, Coventry, R. I., assignor to the Nitrogen Corporation, Providence, R. I.—1,526,580.

Method and Apparatus for the Magnetic Separation of Materials. Georg Ullrich, Magdeburg, Germany, assignor to the Firm Fried. Krupp Aktiengesellschaft, Grusonwerk, Magdeburg-Buckau, Germany. — 1,529,970.

Process or Method of and Apparatus for Magnetic Centrifugal Separation. Orrin B. Peck, Jr., Los Angeles, Calif.—1,527,069.

Dust Separator. Joseph B. Taylor, Allendale, N. J.—1,527,235.

Compressor. Harold W. Wishart, Clinton, Iowa., assignor, by mesne assignments, to Climax Engineering Co., Clinton, Iowa. —1,526,449.

Rotary Compressor. Harold W. Wishart, Clinton, Iowa, assignor, by mesne assignments, to Climax Engineering Company, Clinton, Iowa.—1,526,450.

Rotary Pump. Henry Reginald Arnulph Mallock, Exeter, England, assignor to American Cellulose and Chemical Manufacturing Company, Limited.—1,526,356.

Rotary Pump. Pierre Jouanneaux, Paris, France.—1,526,343.

Gyratory Crushing Machine. William Stevenson Weston, Columbia, S. C., assignor to Weston and Brooker, Engineers, Columbia, S. C.—1,528,741.

Crusher. Richard Bernhard, Allentown, Pa., assignor to Traylor Engineering and Manufacturing Co., Allentown, Pa. — 1,528,316.

Air Cooler. William Wishart and Albert H. Morrell, Clinton, Iowa, assignors, by mesne assignments, to Climax Engineering Co., Clinton, Iowa.—1,526,448.

Apparatus for Producing Aluminum Chloride. Frank W. Hall, Port Arthur, Tex., assignor to the Texas Co., New York, N. Y.—1,530,493.

Apparatus for Producing Carbon Black. Charles F. Crommett, Chelsea, Mass., assignor of one-third to Wilford J. Hawkins, New York, N. Y., and one-third to Louis N. Wheelock, Boston, Mass.—1,528,007.

Method of Impregnating Wood. William C. Zeller, Perth Amboy, N. J.—1,527,726.

Method and Means for Handling Hot Asphalt or Similar Material. Frank H. Gilchrist, Joliet, Ill., assignor to the Flintkote Co., Boston, Mass.—1,528,822.

Method and Apparatus for Indicating Variations in the Proportions of a Gas Mixture. Leland M. Willey, Schenectady, N. Y., assignor to General Electric Co.—1,527,721.

News of the Industry

Costs of Production Are Not Trade Secrets

Court Decision Orders Tariff Commission To Make Public Investigation Findings

A decision declaring that costs of production are not trade secrets and hence are not entitled to be held in confidence by the Tariff Commission threatens to greatly hamper the work of that body under the flexible tariff.

The decision was handed down April 6 by the District of Columbia Court of Appeals in the suit of the Norwegian Nitrogen Products Co. against members of the commission. Technically, the commission won inasmuch as the Court affirmed the decision of the lower court sustaining the commission's demurrer and dismissing the bill but this was done only because the court declared the case moot as the President, during the litigation, had acted on the report of the commision in the case at issue. But the opinion stated that the petitioner had been deprived of legal rights by the commission.

The case grows out of an application under the flexible tariff filed by the American Nitrogen Products Co., of Seattle, Wash., for an increase in the duty on sodium nitrite. The application was opposed by the Norwegian Nitrogen Products Co., representing producers of this chemical in Norway. At the public hearing, Attorney Marion DeVries, representing the Norwegian company, demanded to see the full application filed by the American company, parts of which had been deleted by the commission as confidential before it was made public, and also demanded to see wage costs, power costs and other items of cost of production as gathered by the commission's agents in the domestic field during the investigation. Demand also was made for the right to cross-examine the agents and experts of the commission. All demands were refused, the commission holding that costs of production of individual companies were trade secrets. The Norwegian company sued for a writ fo mandamus to compel disclosure of the information. The District of Columbia Supreme Court sustained a demurrer filed by the commission and dismissed the petition. An appeal was filed and in the meanwhile the President acted on the commission's report and increased the duty on sodium nitrite from 3c per lb. to 4½c. per lb.

It was because the President had issued his proclamation that the Court of Appeals of the District affirmed the lower court in the case, but the opinion sets forth that costs of production are not trade secrets; that in denying access to them the commission deprived the Norwegian company of its rights to prepare an adequate defense in the case; and also that cross-examination of agents of the commission should have been permitted.

In an official statement the Tariff Commission points out that it has no authority to compel foreign producers to disclose their costs of production and that none will do so if the costs are to be open for inspection. The practice has been to give costs in averages only. Domestic producers also would refuse to co-operate with the commission if their individual costs were to be disclosed, other observers believe, and would hamper its work although under the law they can be compelled to open their books. It is feared that if the ruling becomes binding upon the commission, cases might be instituted merely to ascertain the costs of competitors.

As the decision, technically, was in its favor, the Tariff Commission cannot appeal to the United States Supreme Court. The Norwegian company may appeal and its attorney is preparing a petition to request the President to rescind his proclamation in the sodium nitrite case so that the case may be reopened by the commission. Members of the commission, however, favor an entirely new test case in court which may be carried to the United States Supreme Court on broader issues involving the protection of costs of production as trade secrets. In the nitrite case, there was only one domestic producer and to give cost figures would have disclosed its exact figures. A test case is being sought in which the right to protect individual figures can be carried to the highest court.

Members of Muscle Shoals Commission

John C. McKenzie, former Representative from Illinois.

Nathaniel B. Dial, former Senator from South Carolina.

Harry A. Curtis, professor of chemical engineering, Yale University.

William McClellan, electrical engineer, member of McClellan & Junkersfeld, construction engineers, New York City.

Russell F. Bower, member of American Farm Bureau Federation.

Large Attendance at Spring Meeting of A. C. S.

The Spring meeting of the American Chemical Society was held in Baltimore, April 6 to 10, with about 1,200 in attendance. The usual programs of the technical divisions were supplemented by excursions to the U. S. Naval Academy at Annapolis and to the Aberdeen Proving Ground of the Ordnance Department, U. S. Army and by numerous social functions.

At the Council meeting a number of important items of business of the society were transacted. After three years as a section there was founded the Division of Gas and Fuel Chemistry and proposed by-laws for it were adopted. Invitations were accepted for future meetings as follows: Spring of 1926, Tulsa, Okla.; Fall of 1926, Philadelphia, to be the semi-centennial meeting of the society; and Spring of 1927, Richmond, Va. The meeting for August 1925 had previously been decided for Los Angeles, Cal.

Only a few officers of the society were elected at the Baltimore meeting, as it was the semi-annual session, but the following were selected to succeed themselves: Wm. McPherson, as member of the executive committee of the council, W. A. Noyes, editor of scientific monographs, H. E. Howe, editor of technologic monographs, and the two associate editors whose terms expired. Three new associate editors were authorized to make this board of nine members.

Some of the technical papers given at the meetings will be reviewed later. Elsewhere in this issue is a report of the corrosion symposium before the industrial division, the outstanding technical feature of the convention program.

Georgia Central Will Aid in Ceramic Research

The Central of Georgia Railway has concluded a co-operative agreement with the Georgia School of Technology for study and research of certain commercial phases of kaolins and bauxites. The research will be under the direction of Doctor Arthur V. Henry of the Ceramic Department of the Georgia School of Technology. Doctor Henry is a graduate of Ohio State University in ceramic engineering. Doctor Henry will collaborate with R. T. Stull, assistant general industrial agent, Central of Georgia Railway, formerly chief ceramist of the Bureau of Mines at Columbus, Ohio.

News in Brief

Local Section of A.I.C.E. Formed at Chicago — A local section of the American Institute of Chemical Engineers has been formed at Chicago. Officers are: F. L. Dunlap, chairman, F. E. Dodge, vice-chairman, and G. B. James, secretary-treasurer. This is the second local section to come into existence, the first having been established at Detroit.

Revised Tire Specifications—The Federal Specifications Board has issued a revised specification for pneumatic tires, solid tires, and inner tubes purchased by the government. These specifications cover construction and performance requirements for all the principal types of automotive tires purchased by the government and are compulsory for all such purchases after June 27, 1925.

Toronto Will Establish Ceramics Course—Arrangements are being completed for the establishment of a course in ceramics at the University of Toronto. It is expected the course will be started at the autumn session.

Bureau of Mines Transfer in Doubt —Legal aspects of the proposed transfer of the Bureau of Mines to the Department of Commerce by executive order are being studied. Some are of the opinion that this bureau may not be transferred in this manner, since it was created since the act authorizing the transfer of bureaus to the Commerce Department. Others are of the opinion that there is no legal barrier to the transfer.

Montan Wax in Germany—At present Ge man production of Montan wax is estimated at a maximum of 6,000 metric tons annually. Two companies produce it in connection with their lignite distillation operations. For this purpose they own or control the best Central German lignite deposits with the higher bitumen content.

Malleable Glass in Austria — Consumers and manufacturers of glass in the United States are manifesting much interest in the claim that so-called malleable glass has been produced successfully in Austria. No such patent has been registered as yet in the United States Patent Office. The effect of such a development would be particularly far-reaching, it is recognized. The automobile industry alone would absorb immediately vast quantities of a non-shattering glass. A glass that could be moulded and that would lend itself to shaping, as is claimed for the Austrian product, would expand very greatly the uses to which glass now is put.

Trade Associations Await Court Decisions — Some objections has been raised to the proposal that no further representations be made to the Department of Justice concerning trade associations until the Supreme Court decides certain pending cases. These cases, it is said, do not involve the main issues in doubt. While there is hope that the court will hand down broad pronouncements in these cases, the usual practice is to confine opinions to the points immediately involved. Much would be gained were the court, in the course of its opinion, to set up some classifications. All manner of organizations now are known as trade associations. Some are such in fact. Some are scientific bureaus. There are many that stand in between.

A. S. T. M. Committee Meetings— Meetings of twelve committees of the American Society for Testing Materials, in the Non-Metals Division, were held at the Bellevue-Stratford Hotel, Phildelphia, March 25, 26 and 27. They were attended by about 200 members and visitors.

National Leather Exhibition at Newark —The Newark Museum's National leather exhibition will open Oct. 15, 1925. This date has been decided upon after consultation with the Tanners Council, the American Sole and Belting Leather Tanners, and other leading organizations in the leather industry. The exhibit will continue in the Newark Museum for 6 weeks to 2 months, when it will be divided into several smaller exhibits which will be sent to museums, libraries, and chambers of commerce throughout the United States.

Canada Gains Lead in Newsprint Production — In February, Canada reached first position in world production of newsprint after being a close second for many years, with an output of 115,624 tons for the month. Canada exceeded the United States production by 1.793 tons. In shipments also, Canada led. with 116,595 tons, compared with 114,048 tons for the United States.

Hoover Urges Study of Oil Pollution —Before any hard and fast law is enacted to prevent oil pollution on inland waterways the whole problem should be studied carefully, Commerce Secretary Hoover believes. All streams cannot be judged from known conditions on a few. To eliminate pollution on some streams would lay an unjustifiable burden on many communities as well as on certain industries.

Germany Considers Control of Dye and Potash Industries

Government operation of both the dye and potash industries is being considered in Germany. The plan is said to present certain advantages in enabling Germany to meet her reparation payments.

Germany is thought to be particularly anxious to increase her potash exports. The world can absorb potash in much greater quantities than it now is doing, it is believed. Because of the small amount of potash production elsewhere Germany feels that payments in this commodity will arouse the minimum of opposition.

Attempts to pay reparations or to build up credits with dyes and chemicals will arouse other countries with a chemical industry, but apparently the German government is planning to take over several industries with the idea of pushing the maximum amount of the products into export and getting wealth out of Germany, thereby making possible the discharge of reparation responsibilities.

Basic Methanol Patent Is American Owned

The large imports of methanol which have flooded American markets and demoralized the wood chemicals industry have been from synthetic process plants operating under the Badische Co. patents. What appears to be the basic patent of this group is the same as U. S. Patent 1,201,850 granted Oct. 17, 1916, to two Germans who assigned it to the Badische Co. This patent is one taken over by the Alien Property Custodian during the World War and subsequently sold to the Chemical Foundation, Inc.

Under the rules governing licenses by the Chemical Foundation, right to use this process will be granted on identical terms to all companies which may use it, no exclusive licences being granted to any one.

The patent is very broad, covering all sorts of reactions in which hydrogen combines or reacts with compounds of carbon at high pressure and high temperature under the influence of a catalyst. To make methanol, hydrogen and carbon monoxide react in contact with a zinc oxide catalyst.

It is forecast that several large companies will use this process, especially those concerns which are familiar with direct synthetic ammonia processes, to which there is striking technical similarity. Two companies have already decided, it is reported, to go into the synthetic methanol field and others having interest in solvents are expected to follow suit.

Bill Regulating Film Production Passed at Albany

The Webb bill amending the general business law, in relation to the regulation of the manufacture, purchase, lease, use, sale or similar disposition of motion picture film of a nitro-cellulose or similarly hazardous base and removing existing restrictions on the manufacture, purchase, lease, use, sale or similar disposition of motion picture film of an acetate of cellulose or similarly non-hazardous base, passed the Senate at Albany on March 24 and was approved by the Assembly on the following day. A public hearing was granted on April 13.

Its enactment into law will mean that the present base used in the manufacture of film will be rendered obsolete and a new base substituted. A similar measure introduced last year was vetoed by the Governor. The bill this year differs from the one of last by providing that the license for the manufacture, acquisition, holding, use and disposition of hazardous film shall be issued by the proper local official instead of by the state department of labor.

News from Washington

By Paul Wooton
Washington Correspondent of *Chem. & Met.*

MUSCLE SHOALS continues to occupy the center of the stage at Washington although it has had to share the lime-light with the latest rebuff administered the Department of Justice in the Chemical Foundation suit; with the Franco-German potash agreement; and with the serious situation in which the wood alcohol industry finds itself. In addition, various developments of somewhat lesser importance have crowded into the stage with the result that the chemical specialists in Washington have had a hectic month.

The Commission

The President on March 27 made the anxiously-awaited announcement of his selections for the Muscle Shoals Commissioin. They were: John C. McKenzie, former Representative from Illinois; Nathaniel B. Dial, former Senator from South Carolina; Harry A. Curtis, Professor of Chemical Engineering at Yale University; William McClellan, Electrical Engineer, of New York; and Russell F. Bower of the American Farm Bureau Federation.

There seems to be some disappointment with the selections, but this is tempered by the realization that the commission is certain to oppose government operation. Those interested in seeing the maximum amount of power made available for distribution throughout the South fear that the commission as constituted will be inclined toward the subsidizing of fertilizer production with power, with the probabilities favoring the use of a small proportion of the power for fertilizer manufacture, the remainder going into electro-chemical operations. Some think the American Farm Bureau will dominate a majority of the commission. Others are of the opinion that two of the members will act as a unit on some of the major points involved, while two others will take opposite views, thus leaving the balance of power in the hands of former Senator Dial.

The record of other commissions, however, indicates that much of the concern being manifested is needless. Congress usually shows supreme contempt for their deductions. Legislation usually is influenced by the facts developed rather than interpretations based on them. There is every reason to expect that this commission will do a good job of fact-finding. While most of the facts already have been found, they never have been marshalled in an orderly way or stripped of extraneous matter. Congress, therefore, is expected to be influenced more by the text of the Commission's report than by its conclusions.

There will be at least two bidders for the temporary use of Muscle Shoals power. It has been known for some time that the Associated Power Companies in the Southeast would submit a bid. The Secretary of War was asked on April 3 by the Union Carbide Company for permission to bid for the temporary lease. As this is written, the War Department is about to advertise for bids. One of the conditions of the Carbide Company's bid is understood to be a temporary lease on nitrate plant No. 2.

Future of Cramton Bill

The general feeling of satisfaction within the industry because of the defeat of the Cramton Prohibition Bureau Bill is giving way to a new anxiety as to what may happen at the next session, letters reaching Washington indicate.

While all bills die at the end of a Congress, those that have made legislative progress quickly acquire the same status at the next session. This means that the Cramton bill will make rapid progress when Congress convenes again. Because of the questionable tactics employed in getting this particular measure through the House it may come in for more scrutiny than is usual in the case of legislation previously approved by the body.

There is evidence of a well defined feeling among the producers and most consumers of industrial alcohol that their legislative tactics must be revised. Instead of being always on the defensive and appearing in the role of objectors many suggestions have reached Washington that the industry prepare a bill which will put in legislative form its constructive suggestions as to the proper means of meeting the situation. It would be more seemly, it is contended, to have the industry in the role of a champion of affirmative legislation rather than always to be appearing before congressional committees as opponents of legislation.

Those who are indifferent to the needless burdens which are heaped on industrial alcohol are losing no time during the interim between sessions to misrepresent the situation. With all the prestige of the Methodist Church behind it, the Board of Temperance, Prohibition and Public Morals of that organization is broadcasting to the country a positive statement to the effect that the bootleg trade in the eastern cities is turning more and more to redistilled industrial alcohol as the growing efficiency of the Coast Guard is reducing the smuggled supply. Incidentally this agency of the Methodist Church has been called upon formally to divulge the facts which served as the basis for bringing this statement into existence.

"The appointment of the new supervisor of prohibition and customs in the Treasury Department does not change the status of Commissioner Haynes or Internal Revenue Commissioned Blain," said Wayne B. Wheeler, General Counsel of the Anti-Saloon League of America. "The reorganization of prohibition enforcement, as proposed by the Cramton-Sterling Bill, is as essential as ever. Such an appointment, as incidental to reorganization has been urged by dry organizations and other groups for over a year."

With the vanishing of the early doubt as to the value of the German methyl alcohol discovery has come a mixed feeling of regret and of satisfaction. The regret is for the $100,000,000 wood alcohol industry in this country which has been thrown into such a serious position by the new process. The satisfaction springs from the new example of what may be accomplished by sheer research. It will do much, it is believed, to spur American chemists to new efforts.

Boll Weevil Control

In this connection it may be of interest to call attention to an interview given out by Representative Kemp of Louisiana, on leaving Washington at the close of the recent session of Congress. He pointed out that the boll weevil is taking a toll of more than $200,000,000 annually. He thinks its control lies in the field of chemical research. He urged that chemists concentrate on this problem, not only because of the public service involved but because of the unprecedentedly large prize which awaits the man who can devise some means of reducing the losses now being suffered.

The Bureau of Entomology of the United States Department of Agriculture has just completed the annual examination made for the purpose of determining the survival of boll weevils in Spanish moss. The records indicate that as far as the initial emergence of the weevil is concerned, the Southeastern States may expect at least a normal number, sufficient, in fact, to be a serious control problem from the very beginning of the season in those fields nearest to hibernation shelter. From Alabama westward, however, it is evident that a lighter infestation will prevail on the average with the possible exception of the extreme Gulf Coast regions, but it is also evident that this infestation is going to be very abnormally "spotted."

The State Department, it is understood, sees no ground on which to base the complaint against the Franco-German Potash Combine. Prices are averaging below those of 1913. It is certain, however, that the situation will be watched carefully. If evidence should be forthcoming that the merger is being used to force prices up to artificial levels, it is anticipated that diplomatic representations would be made.

In this connection, however, it is pointed out that independence from possible exactions of the potash producers in France and Germany can come only through the development of our own resources. The very fact that the merger has taken place is expected to insure the final passage at the next session of Congress of the Sheppard bill authorizing the expenditure of $500,000 for prospecting for natural deposits and the encouragement of production from other sources. That bill passed the Senate and would have gone through the House had it not been blocked by the Director of the Budget.

Demand for Changes Expected to Open Tariff Question

So many interests are demanding changes in the tariff law that it is difficult to see how the administration will be able to carry through its announced purpose of not opening up the question. The President thinks any inqualities in the act can be reached by the flexible provision.

The clamor for the opening up of the tariff is not confined to those who want lower duties. Those who think higher duties should prevail are just as insistent. In addition there is a strong demand for changes in the administrative provision. These, they say, are archaic and cumbersome. This demand is coming from Protectionists. The flexible tariff also has its enemies who want to see it eliminated from the law.

Consumers for the most part are unorganized. In many instances the immediate consumers of imports are large manufacturers or middlemen who have no difficulty in passing on the amount of the duty. With certain exception they will stage only a sham battle. Tariff rates are overthrown by waves of public sentiment, and they are not put in motion quickly and only then when injustices are glaring.

So far as the chemical schedule is concerned it appears to have the sympathy of the public. The large consumers are its only active enemies, but as they are the recipients of an unusual degree of protection themselves their influence is limited.

There is marked feeling against some items in the metal schedule, but those who want these rates continued are well organized, whereas those who pay the bill have shown no indications of having been aroused to the point of concerted protest. There will be an intensive effort to open the four textile schedules, since the manufacturers feel that they must have higher rates. The wool manufacturers long have been clamoring for reductions. In the sundries schedule many items are under attack. Increases for some articles are sought and decreases for others. The pottery and earthenware schedule has created no little dissatisfaction.

It is the agricultural schedule, however, that is being debated most and which is likely to force Congress to consider tariff matters at its next session. To have the tariff the subject of discussion on the eve of congressional election is the one thing which the administration will avoid if it can, but the chances seem to be against its success in that connection.

Rapid Increase in Output of Pyroxylin Varnishes

The Department of Commerce announces that, according to data collected at the latest semi-annual canvass of paint and varnish manufacturers, there was produced from July 1 to Dec. 31, 1924, 233,866,900 lb. of paste paints, comprising 152,552,700 lb. of white lead in oil, 5,961,600 lb. of zinc oxide in oil, and 75,352,600 lb. of other paste paints; 43,151,600 gal. of ready-mixed and semipaste paints; 32,141,100 gal. of varnishes, japans, and lacquers, other than pyroxylin; and 2,160,300 gal. of pyroxylin varnishes or lacquers.

The statistics for the last half of 1924 as compared with the first half of that year show decreases of 7.8 per cent for paste paints, 4.4 per cent for ready-mixed and semipaste paints, and 7.4 per cent for varnishes, japans, and lacquers, other than pyroxylin, while for pyroxylin varnishes or lacquers an increase of 51 per cent is recorded. The first half of 1924 as compared with the last half of 1923, however, shows increases of 32.1, 17.7, and 5.7 per cent, respectively, for the first three of the above-named classes of products. Pyroxylin varnishes were first reported in 1924. Comparison of the last half of 1924 with the last half of 1923 brings out increases of 21.8 per cent and 12.5 per cent, respectively, for paste paints and ready-mixed and semipaste paints, and a decrease of 2.2 per cent for varnishes, japans, and lacquers, other than pyroxylin.

Equipment Manufacturers Invite A.C.S. to Providence

Charles L. Parsons, secretary of the American Chemical Society, received a telegram last week from the Association of Chemical Equipment Manufactu· rs in which an invitation was extended to the entire membership of the A.C.S. to attend the Chemical Equipment Exposition which will be held in Providence, June 22-27. The invitation stated that the exposition will be strictly one of the relation of chemical processes, engineering and equipment to productive industry. Admission is by registration, and while the general public is excluded, every person qualified by an industrial interest, from shop men and plant foremen up through superintendents, executives, stockholders, purchasing agents, owners, engineers, chemists and laboratory chiefs, etc., from the chemical and chemically controlled industries, technical educators and students, government technicians, experts and purchasing agents, is welcome and is sought.

C. W. S. Will Train One Hundred Reserve Officers

The present plans of the Chemical Warfare Service for the training of reserve officers during the fiscal year 1925, commencing July 1, contemplate calling to active duty approximately 100 officers for periods of 15 days. If the necessary funds are allotted, about 25 of the officers will be ordered to Edgewood Arsenal, and the same number to schools to be established in the 8th and 9th Corps areas, the headquarters of which are located in San Antonio, Texas, and San Francisco, California, respectively. The remaining 25 officers will be given training in Corps Area Headquarters, at the Headquarters of Procurement Districts, and in the office of the Chief, Chemical Warfare Service, War Department. Three or four officers will probably be sent to the Chemical Warfare School to pursue the Line & Staff Officers' Course.

British and German Dye Makers Divide Markets

Apparently the British and German dye makers are carrying through indirectly a part of the merger program which they were prevented from adopting. Reports are to the effect that the British have agreed to stay out of Spain and Portugal. There is reason to believe the partitioning of markets under a gentleman's agreement has gone much further.

With the presence of the United States, a third powerful competitor in the field, it is not clear just what the British and the Germans hope to accomplish. If prices are raised, following the withdrawal of one or the other from any country's market, that market would become especially attractive to American competitors.

Increase in Imports of Dyes in March

Compilations made by the Bureau of Foreign and Domestic Commerce show that importations of synthetic and coal-tar dyes gained in volume for the month of March. The following figures give details of imports and the stocks in bonded warehouse:

IMPORTS OF SYNTHETIC DYES

	1925		1924	
	Lb.	Value	Lb.	Value
Jan....	403,984	$359,376	238,643	$237,868
Feb....	373,259	365,268	161,869	180,570
March	527,964	488,501	302,799	307,247
Total 3 mos.	1,305,207	$1,213,145	703,311	$725,685

Imports of coal-tar dyes for the month of March, 1925, by ports are as follows:

	Lb.	Value
New York	514,677	$478,607
Boston	9,160	6,195
Providence	3,925	3,472
Philadelphia	102	117
Detroit	100	110
Total	527,964	$488,501

LEADING DYES IMPORTED DURING MARCH

Leading Dyes	Imported During March
Rhodamine B	39,540 lb.
Brilliant indigo 4B	27,209 lb.
Ciba violet B	23,803 lb.
Indanthrene yellow G	16,776 lb.
Rhodamine 6G	14,155 lb.

DYES REMAINING IN BONDED CUSTOMS WAREHOUSE

	Coal-Tar Dyes and Colors Lb.	Coal-Tar Intermediates Lb.
Aug. 31, 1924	507,338	1,081,287
Sept. 30, 1924	559,661	1,111,656
Oct. 31, 1924	552,556	1,050,037
Nov. 30, 1924	533,760	1,031,460
Dec. 31, 1924	575,051	1,086,108
Jan. 31, 1925	571,371	952,202
Feb. 28, 1925	566,038	961,406

Graduate Course in Chemical Engineering at Columbia

Columbia University is offering a graduate course in chemical engineering to a limited number of qualified students. The course will open on June 1 and will extend over a period of 6 weeks. It will comprise an intensive study of the unit operations in chemical engineering and will occupy the student's entire time during that period.

Court of Achievement Planned for Chemical Exposition

One of the outstanding features of the Tenth National Exposition of Chemical Industries to be held Sept. 28 to Oct. 3, at Grand Central Palace, New York, is a Court of Chemical Achievement for the exhibition of conspicuous developments in American chemical industry during the past few years. The purpose of the plan, which was recently inaugurated by the Advisory Committee of the exposition, is to gather together in one group a large number of small unit exhibits of recent American chemical products, equipment and processes in order to emphasize the achievements of American chemistry, whether in scientific research or in industrial application.

All exhibits intended for the Court of Achievement will be passed upon by a committee of approval, selected from the American Chemical Society and comprising Marston T. Bogert, chairman, C. M. Stine, E. R. Weidlein, F. W. Willard and John Johnston. A special committee of the Chemical Exposition Advisory Board composed of H. E. Howe, chairman, F. J. Metzger and T. B. Wagner, will act in an advisory capacity to the exposition management in the general conduct of the new project. Entries must be made prior to May 1.

Worthington Wins Litigation Over Gyratory Crushers

On the refusal of the United States Supreme Court to review the case of Worthington Pump and Machinery Corporation vs. Traylor Engineering and Manufacturing Co., the United States District Court for the eastern district of Pennsylvania has made effective its injunction restraining the Traylor company from manufacturing, selling or using gyratory crushers, covered by claims of U. S. Patent No. 960,231. The decision in the original suit for infringement was handed down by Judge Dickinson of the District Court sustaining the claims of the patent and holding that the Traylor Bull Dog crusher was an infringement of the Superior McCully crusher of the Worthington company. This decision was affirmed Oct. 1, 1924, by the United States Circuit Court of Appeals, which later, denied a petition for rehearing. On refusal of the United States Supreme Court to review the case, the injunction of the District Court was made effective March 23, 1925. The Allis-Chalmers Manufacturing Co. of Milwaukee, is the only company now licensed by the Worthington company to manufacture gyratory crushers under this patent.

Detroit Aero Metals Co. Has Been Reorganized

The Detroit Aero Metals Co., which fell into disrepute under the management and direction of Glen Lenardo Williams, has been completely reorganized with Dr. Richard Moldenke in charge of all technical operations. Williams is the self-styled "Doctor" whose methods of promotion and technical processes were exposed in *Chem. & Met.*, March 24, 1924. He was also attacked by the Detroit Board of Commerce and the Better Business Bureau for his questionable business methods. Williams' connection with the Detroit Aero Metals Co. has been severed completely and the reorganized company is again in good standing with the business interests of Detroit, and with the Michigan Securities Commission. The appointment of Dr. Moldenke is regarded as substantial evidence that the interests of the stockholders will be conserved to the greatest possible extent. Announcement of the new program of operations will not be published until experimental work now under way has been completed.

Domestic Production and Sales of Dyes Declines

Preliminary figures compiled by the United States Tariff Commission indicate a domestic production for 1924 of about 67,000,000 lb. of coal-tar dyes, with a value of about $36,000,000. This quantity represents a 28 per cent decline from that of 1923, which was the largest in the history of the industry. The sales of dyes in 1924 were about 63,200,000 lb. with a value of $33,800,000. This is a 27 per cent decrease in quantity and a 28 per cent decrease in value from sales during 1923.

The principal reason for the decline in quantity of the dye output in 1924 was the decreased activity of the textile industry. Among other factors contributing to a reduced production were (1) stocks carried over from 1923, amounting to over 7,000,000 lb.; (2) increased imports following the 15 per cent reduction in the tariff, effective September 22, 1924, and (3) a reduction in exports amounting to 2,211,000 lb.

The following table shows a comparison of domestic production and sales for 1914 and 1920 to 1924, inclusive.

Production and Sales of Coal-Tar Dyes

Year	Production Lb.	Sales Lb.	Sales Value
1924	67,000,000	63,200,000	$33,800,000
1923	93,667,524	86,567,446	47,223,161
1922	64,632,187	69,107,105	41,463,700
1921	39,008,690	47,513,762	39,283,956
1920	88,263,776	.....	.....
1914	6,619,729	.....	.....

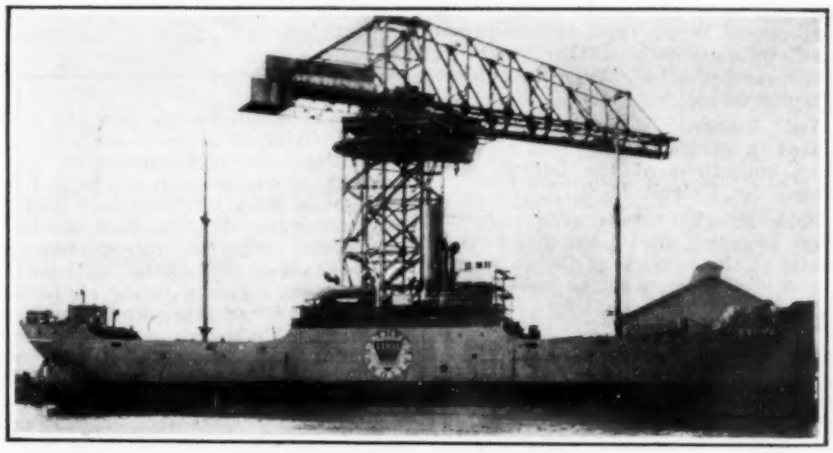
Turpentine Production Makes Headway in Canada

The Brown Corporation, at their plant, at La Tuque, Quebec, is producing what is called La Tuque turpentine, which is claimed to be fully equal for most purposes to that made elsewhere. Canada heretofore has imported her total turpentine supply, amounting annually to more than 1,000,000 gal. It is claimed that in the new product moisture and free rosin are eliminated, and the turpentine is practically colorless, thereby being particularly valuable for painting purposes.

Floating Factory to Recover Bromine From Sea Water

The du Pont Company has practically completed the equipment of the S. S. *Ethyl* for the extraction and recovery of bromine from sea water and the vessel will shortly be placed in active commission. This project has been undertaken for the Ethyl Gasoline Corporation in order to supply its rapidly increasing demand for bromine used in the manufacture and application of tetra-ethyl lead as an anti-knock compound for internal combustion engines. The ship is a lake-type oil burner carrying a crew of 55 men with special quarters for about a dozen chemists comprising the operating and control staff. Special laboratories and hospital quarters have also been provided.

When the *Ethyl* puts to sea on her maiden voyage she will be a floating chemical factory of the first order. She is equipped with pumps, mixing apparatus, filter presses, etc., for the treatment of 7,000 gallons of water per minute. As sea water contains about 0.0064 per cent bromine the production will amount to 4-5 pounds of bromine per minute. Details of the process have not been made public but it is understood that sea water is rapidly and intimately mixed with the necessary chemicals, resulting in the precipitation of a bromine compound that is subsequently recovered in filter presses. The process is continuous. It was originally worked out in the du Pont Experimental Laboratory in Wilmington and later developed on a larger scale at Ocean City, N. J.



Du Pont Bromine Ship "Ethyl"

Men You Should Know About

Hugh E. Weightman has returned to engineering practice after having been, for the past several years, employed exclusively by the Maphite Company of America, as chief of its consulting engineering department. Mr. Weightman's practice will now be limited to consultation on refractory and fuel problems for manufacturers and consumers. He can be addressed at 518 Central National Bank Building, St. Louis, Mo.

Dr. J. H. Hildebrand, professor of chemistry and dean of men, University of California, has made a signal contribution to the subject of caisson dis-

Keystone View Co.

Dr. J. H. Hildebrand

ease. In continuation of his work on solubility, and recognizing that the substitution of a less inert and less soluble gas than nitrogen might be suitable as an alternative atmospheric constituent under such conditions, he proposed the use of helium-oxygen mixtures. Preliminary tests by the U. S. Bureau of Mines have demonstrated that, by taking advantage of the suggestion, the time of decompression is capable of marked reduction; and indications point to the conclusion that the use of the substitute atmosphere will serve to mitigate caisson disease. The development of Dr. Hildebrand's idea was placed in the hands of Dr. R. R. Sayers and W. P. Yant, of the Bureau staff, who are joint authors with Dr. Hildebrand of a bulletin on the subject, recently issued.

Dr. Richard Moldenke has been placed in complete charge of all technical operations of the Detroit Aero Metals Co., Detroit, Mich.

John Frank Stevens, civil engineer, was awarded the John Fritz Gold Medal at the meeting of the four leading American engineering societies, at the Engineering Societies Building, New York, on March 23.

William A. Simkins, who was formerly in the chemistry department of the Ohio Agricultural Experiment Station, Wooster, Ohio, is now with the Bureau of Mines in the gas laboratory on ethyl gas investigation.

Dr. H. K. Endell, a well-known ceramic engineer of Germany, specializing in refractories, is visiting the United States, making a tour of different sections prominent in refractory operations. He is accompanied by his associate, Dr. F. W. Steger.

Robert G. Kneale, secretary and treasurer of the Pontiac Varnish Co., Pontiac, Mich., has been elected president of the Pontiac Board of Commerce.

Elizabeth Gilman, of Gardner, Mass., has been appointed research assistant in chemistry at Yale University, New Haven, Conn. She is the first woman ever to have been selected in such capacity at the institution, the appointment having been previously held by men showing marked ability in research. Miss Gilman is a graduate of Mount Holyoke College, '23, and has been acting as assistant in the department of organic chemistry at that institution.

N. H. Graesser, director of the Graesser-Monsanto Chemical Works, Ruabon, North Wales, a visitor to the United States for several weeks, has sailed for England and will soon return to his office.

C. W. Stratford, for six years connected with the Associated Oil Company's operations in California, during

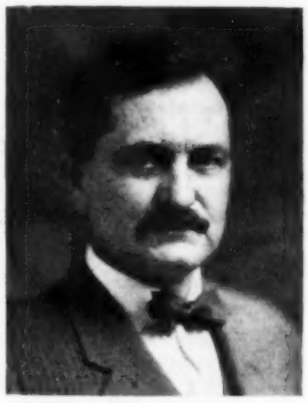
C. W. Stratford

several of which he has held the position of chairman of the manufacturing committee, has been appointed technologist, in charge of research and investigation work affecting manufacturing processes. Mr. Stratford has been responsible for the introduction of many changes in refining methods at the company's plants during his tenure of office, and has taken an active part in the establishment of the research laboratory at Avon, Calif. He relinquishes the chairmanship of the manufacturing committee to O. P. Cottrell, formerly a research chemist and latterly superintendent of Tract No. 1, where lubricating oils are processed.

J. Wilbur Towsen, of Williamsport, Pa., for the past five years industrial relations manager of the Lycoming Rubber Co., with the local plant, has been appointed assistant supervisor of industrial relations of the United States Rubber Co., New York.

Dr. Franz Fischer, editor of *Brennstoff Chemie*, is visiting educational and research centers in the United States, where fuel problems are under investigation.

Harry A. Curtis, professor of Chemical Engineering at Yale University, has been appointed by President Coolidge as a member of the Commission to advise Congress on the best disposition of Muscle Shoals. He was in the Nitrate Division of the Ordnance Department for the period of the War. In 1919-20 he was professor of chemistry



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Dr. Harry A. Curtis

at Northwestern University, leaving there to join the International Coal Products Corporation, first as chief chemist and later as plant superintendent. Prior to undertaking his present work at Yale, he was general manager of the Clinchfield Carbocoal Corporation. During 1923 he made a nitrogen survey for the Department of Commerce.

Howard E. Drake of 280 Madison Ave. is now a consultant in chemical engineering problems, particularly of the electrochemical type. Mr. Drake was formerly connected with the Gould Storage Battery Co.

Frederick Pope, Charles E. Richardson and Arthur E. Wells announce the formation of a partnership under the name Pope and Co., for the transaction of a general investment securities business. Their offices are at 60 Broadway, New York City.

A. Thau, superintendent of 15 lignite coking plants in central Germany, known to our readers as a contributor on byproduct coking and related topics, has received the honorary degree of Doctor of Engineering from the University of Karlsruhe.

George E. Beavers has been promoted to general superintendent of the Tennessee Copper Company's Tennessee plants at Copperhill.

Dr. M. C. Whitaker, president of the U. S. Industrial Chemical Company, sailed for Europe on March 28. He expects to be gone several months.

A. V. Bleininger of the Homer Laughlin China Co., Newell, W. Va., delivered three lectures to the students of the Department of Ceramic Engineering, University of Illinois, on March 18 and 19. The topics of his addresses were: Work of the Ceramist, Operation of Tunnel Kilns and Research in Factory Practice.

Dr. Edgar F. Smith and Ira Remsen have been elected honorary fellows in the American Institute of Chemists.

Frank Hodson, founder and president of the Electric Furnace Construction Co., Philadelphia, and vice-president of its successor, the General Furnace Co., announces that he has severed all connections with that company and will go into business as a consulting engineer and metallurgist. He can be addressed at 200 Jefferson Building, Philadelphia, Pa.

Donald M. Liddell was elected president of the Crown Cork and Seal Co., of Baltimore, at the annual meeting held March 17.

Dr. C. H. Desch, professor of metallurgy in the University of Sheffield, England, has been appointed president of the section on chemistry, Southampton meeting of the British Association for the Advancement of Science, to be held in the autumn.

Obituary

Dr. Guilford Lawson Spencer, chief chemist of the Cuban-American Sugar Co. since 1906, died in Cuba, on March 23. At the time of his death Dr. Spencer was in his 67th year, having been born at Lafayette, Ind., Dec. 21, 1858. For 40 of these years his career on its professional side has been closely associated with the sugar field, first in the U. S. Department of Agriculture and later as chemist, chief chemist and consultant to sugar manufacturing enterprises in Louisiana, Nicaragua and Cuba. He attended Purdue University where he took a special course in sugar technology and analysis under Dr. Harvey W. Wiley, graduating in 1879, with the degree of B.S. In 1882 he received an M.S. from the University of Michigan.

Zachary Taylor Hollingsworth, noted manufacturer of paper, died April 1 at his home in the Hotel Brunswick, Boston, Mass. Mr. Hollingsworth was born in Milton, Mass., in 1848, and after graduating from the Milton Academy and the Chauncey Hall School in that city, he established himself at the head of his firm of paper manufacturing. In 1882 he went into partnership with Mr. Vose and this concern was incorporated as the Hollingsworth & Vose Co. in 1892, with mills at Boston. Mr. Hollingsworth was president of the paper company.

Thomas H. Leaming died March 28 at Perrysburg, near Buffalo. Mr. Leaming was a graduate of Rensselaer Polytechnic Institute and served as instructor there and later at the University of Missouri. In the early days of the war he entered the laboratories of the National Aniline and Chemical Co., where he was employed until his untimely death. In his chosen field of azo color chemistry, Mr. Leaming rose to the position of an acknowledged authority. In the synthesis of tri- and polyazo dyes, he was singularly successful, but it was for his ability in the more difficult field of dye analysis that he was best known. His uncanny skill in the resolution of colors of unknown constitution earned the admiration and respect of all with whom he was associated. Mr. Leaming was 31 years old. He was a member of the American Chemical Society and of the University Club of Buffalo. He is survived by his widow.

Calendar

AMERICAN CHEMICAL SOCIETY (N. Y. Section), May 1.

AMERICAN ASSOCIATION OF CEREAL CHEMISTS, annual meeting, St. Louis, Mo., June 1 to 5.

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (Northern New England and Rhode Island Sections), Providence, R. I., June 24.

AMERICAN ELECTROCHEMICAL SOCIETY, Niagara Falls, April 23 to 25.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, semi-annual meeting, Providence-Biltmore Hotel, Providence, R. I., June 22 to 25.

AMERICAN LEATHER CHEMISTS' ASSOCIATION, 22nd annual convention, Atlantic City, N. J., June 3, 4 and 5.

AMERICAN OIL CHEMIST'S SOCIETY, sixteenth annual meeting, Roosevelt Hotel, New Orleans, La.., May 11 to 12.

AMERICAN PULP AND PAPER MILL SUPERINTENDENTS ASSOCIATION, Niagara Falls, N. Y., June 4 to 6.

AMERICAN REFRACTORIES INSTITUTE. First regular meeting, Mellon Institute, Pittsburgh, Pa., April 14.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, spring meeting, Milwaukee, Wis., May 18 to 21.

AMERICAN SOCIETY FOR STEEL TREATING, spring sectional meeting, Schenectady. Headquarters, Hotel Van Curler, May 28 to 30.

AMERICAN SOCIETY FOR STEEL TREATING, annual convention and National Steel Exposition, Cleveland, Ohio, the week of Sept. 14.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Atlantic City, June 22 to 26.

AMERICAN WELDING SOCIETY, annual meeting, April 22, 23 and 24.

CHEMICAL EQUIPMENT EXPOSITION, Association of Chemical Equipment Manufacturers, State Armory, Providence, R. I., June 22 to 27.

COLLOID SYMPOSIUM (Third National) University of Minnesota, Minneapolis, Minn., June 17 to 19.

INTERSTATE COTTON SEED CRUSHERS ASSOCIATION, annual convention, Roosevelt Hotel, New Orleans, La., May 13 to 15.

IRON AND STEEL INSTITUTE (British), annual meeting, London, May 7 and 8.

NATIONAL ASSOCIATION OF PURCHASING AGENT, Milwaukee, Wis., May 25 to 28.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES, New York, Sept. 28 to Oct. 3.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING (Fourth), Grand Central Palace, N. Y., Nov. 30 to Dec. 5.

NATIONAL FOREIGN TRADE COUNCIL, Seattle, Wash., June 24 to 26.

NATIONAL LIME ASSOCIATION, 7th annual convention and 23rd annual meeting, Briarcliff Lodge, Briarcliff Manor, Westchester County, N. Y., May 26 to 29.

SOCIETE DE CHIMIE INDUSTRIELLE (in charge), with N. Y. Sections of American Chemical Society, American Electrochemical Society and Society of Chemical Industry, May 8.

SOCIETY OF INDUSTRIAL ENGINEERS, national convention, Hotel Winton, Cleveland, Ohio, May 6 to 8.

SOUTHERN EXPOSITION, Grand Central Palace, New York, May 11 to 23.

Industrial Notes

The paint department and the cellulose products department of the duPont Co. have been consolidated to form a new organization to be known as the Paint, Lacquer and Chemicals Department. William P. Allen, who has been general manager of the Cellulose Products Department, becomes head of the new organization, with William Richter as assistant general manager. William S. Lynch, heretofore connected with the explosives division, has been appointed control manager of the new department, as assistant to Mr. Allen. W. P. Regestein, formerly chief chemist at the Carney's Point plant of the company, has been transferred to the Brandywine, Del., laboratory, to succeed S. C. Lloyd, as ballistic engineer. J. M. Skilling, heretofore technical assistant in charge of chemical work at the Brandywine laboratory, will become connected with the Carney's Point plant, succeeding Mr. Regestein as chief chemist. J. H. Aaron has been appointed technical assistant in charge of chemical operations at the Brandywine laboratory, vice Mr. Skilling, and has previously been engaged at this same station as chemist. C. E. Robinson, heretofore chemist at the Carney's Point works, has been transferred in a like capacity to the Brandywine laboratory. M. L. Valentine, formerly chemist and ballistic engineer at the Haskell, N. J., works, has been transferred to the Carney's Point plant to succeed Mr. Robinson as chemist. E. C. Thompson has been appointed division manager of the Acids and Heavy Chemical Division of the company. J. J. Moosmann has become division manager of the Chemical Products Division, succeeding J. W. Elms, who will be division manager of the Paint Division. J. W. McCoy has become director of the Manufacturing Division, composed of the high explosives and special products manufacturing departments, recently consolidated. J. W. Wellford has been appointed assistant director of the Manufacturing Division in charge of high explosive operations; H. K. Babbitt has been appointed assistant director of the same division, in charge of the manufacture of blasting supplies. Hunter Grubb who was head of the Paint Department has been assigned to special duties.

The Detroit Electric Furnace Co. has moved its office to 2231 Park Boulevard, Detroit, Mich.

The American Bosch Magneto Corp., Springfield, Mass. announces that A. K. Chambers, who has managed the Chicago branch of the corporation during the past four and a half years, became the personal field representative of the general sales manager, with headquarters at Springfield, Mass. He will spend most of his time in the field reporting general conditions to headquarters. Mr. Chambers has been replaced by O. H. Smith, as Chicago branch manager, who was formerly assistant sales manager of the Thermoid Rubber Co.

Market Conditions and Price Trends

Weighted Index Number for Chemicals Reaches Lower Level

Easier Markets for Various Selections Show Price Trend—Values for Oils and Fats Also Move Downward

DECLINES in stocks, grains, and commodities have been quite general during the past month. The reversal in the market for stocks and grains was attributed largely to a natural reaction from conditions fostered by unusually heavy speculative buying. The fall in prices had no direct connection with general industrial conditions, yet the effects were somewhat general in scope as confidence in a boom period in industry das dissipated. The price wave also had a sympathetic influence over a wide area.

The weighted index number for chemicals now registers 112.60 as compared with 113.16, a month ago and 116.31, a year ago. In computing the index number, attention has been given only to the selections on which changes in market quotations have been made openly. The majority of such changes have been in favor of buyers and have depressed the weighted number. A review of the market, however, reveals that many commodities have been offered under the quotation levels and this condition clearly proves that supply is holding above demand and further verifies the easier position of the market as pointed out by the recession of the index number.

The upward movement of oils and facts as reported a month ago was checked during the interval and the weighted number declined from 161.32 to 154.01. Crude cottonseed oil, basic oil of the group, did not change materially but demand for other oils, except linseed, eased off and the lowering in values was indicative of the decline in consuming interest.

A review of some of the industries which are large consumers of chemicals indicates that operations were on a larger scale in February than in the preceding month. Taking as a basis, employment figures of the Bureau of Labor, the following comparisons are found:

INDEX OF EMPLOYMENT

	Feb. 1925	Feb. 1924	Jan. 1925
Dyeing and Finishing Textiles	101.8	95.6	99.9
Leather	95.4	96.5	93.8
Paper and Pulp	94.2	97.4	92.4
Chemicals	92.5	99.5	91.6
Fertilizers	98.	109.6	91.
Glass	91.1	96.2	88.2
Automobile Tires	106.1	93.6	102.9
Petroleum Refining	89.6	93.1	88.8

Tariff Developments

While no changes in existing import duties have been made, the influence of probable revisions was felt as a market factor. The impetus for the downward movement of linseed oil prices undoubtedly arose from belief that the import duty would be lowered and thus invite competition from foreign markets. Later it was felt that the President was exercising a pocket veto and would make no change in the existing duty. This placed the market in a position where values depended on the seed market and later reductions in oil were traceable to lower costs for the oil-bearing material.

Chlorate of potash and chlorate of soda were other commodities on which tariff developments had a bearing. The Tariff Commission, shortly after the first of April, sent to the President its report on chlorates and recommended an increase of 50 per cent in import duty. The present duty is 1½c. per lb. and if the maximum increase possible under the flexible provisions of the tariff act, is granted, the new rate will be 2¼c. per lb. As it had been anticipated that the duty on chlorates would be advanced, market values had shown a tendency to harden and consumers and importers had been buying more actively for shipment to this country.

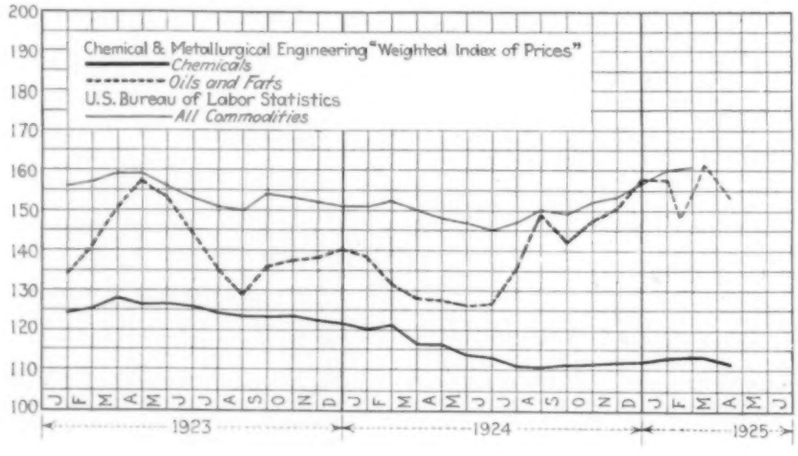
Wood Chemicals Depressed

Some good sized lots of German synthetic methanol have reached this country but arrivals have not been large enough to cause any unwarranted disturbance in the market. It is the knowledge that production costs of the synthetic are too low to be met by the wood distillation product and the assurance that the synthetic material will dominate the future market that has depressed the wood distillation industry. Quotations for methanol, acetate of lime, and other wood chemicals have shown practically no change but there is not much stability to values, although some of these products ultimately may find a much higher sales level as a result of the changed position of raw materials. The application for an increase in import duty on methanol is not expected to afford any relief from foreign competition as the maximum possible under the present law would mean a duty of 18c. per gal. which would not protect domestic makers. Any attempt to have special legislation enacted would be so protracted as to give the synthetic industry an opportunity to become well established in this country as reports credit different companies with the intention of becoming producers.

Foreign Trade Declines

Export trade in chemicals has not been active. Latest official figures are for February. In that month, exports of chemicals reached a valuation of $4,309,371 as compared with $4,791,395 in January and $4,692,533 in February, 1924. The decline in outward shipments is pretty well spread over the chemical list and the falling off is general and not the result of drastic changes in export buying of certain groups or commodities. The fact that unit prices are lower than a year ago would indicate that the comparison with February, 1924, would be more favorable if taken on a basis of quantities rather than values.

Arrivals of foreign chemicals in February were valued at $3,667,620. This shows a marked decline from the January total of $4,122,407 and suffers still more in comparison with the returns for February, 1924, which were reported at $4,576,964. A large part of the decline in import values is found in lessened receipts of coal-tar chemicals from foreign points, dead or creosote oil, alone, accounting for a loss of more than $1,000,000 as compared with February, last year.



Market Conditions and Price Trends

Facts and Figures of Business

in Chemical Engineering Industries

Industrial Statistics Presented Graphically for Those Who Follow the Monthly Trends of Production and Consumption

MANUFACTURING production in February increased 8 per cent over that for the preceding month, when allowance is made for the smaller number of working days, according to the index number of the Department of Commerce. The principal increase over January occurred in the output of automobiles with a gain of almost 20 per cent, while slight increases were shown, when reduced to an average daily basis, in the output of textiles, non-ferrous metals, lumber, leather, and stone and clay products.

The output of raw materials was 5 per cent less in February than a year ago, minerals declining 7 per cent, forestry products 2 per cent, the marketings of animal products 3 per cent and crop marketings 7 per cent, as computed by the Department of Commerce index numbers.

The index of unfilled orders on February 28 increased fractionally over January and was the same as a year ago, iron-and-steel unfilled orders having increased over a year ago while orders for building materials declined.

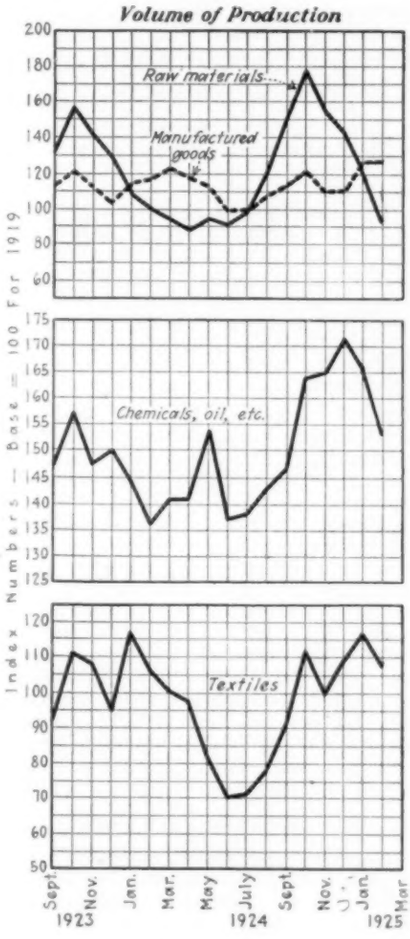
Stocks of commodities held at the end of February showed a decline from January of 4 per cent, when allowance is made for seasonal tendencies, but increased 10 per cent over a year ago. Stocks declined during February in all groups except manufactured food stuffs, while, compared with a year ago, all groups showed increased stocks except raw foodstuffs, which did not change.

A slowing down of the recent upward movement of wholesale prices is shown for February by information, collected in representative markets by the United States Department of Labor through the Bureau of Labor Statistics. The Bureau's weighted index number, which includes 404 commodities or price series, registered 160.6 for February compared with 160.0 for January. The December, 1924, index was 157.0.

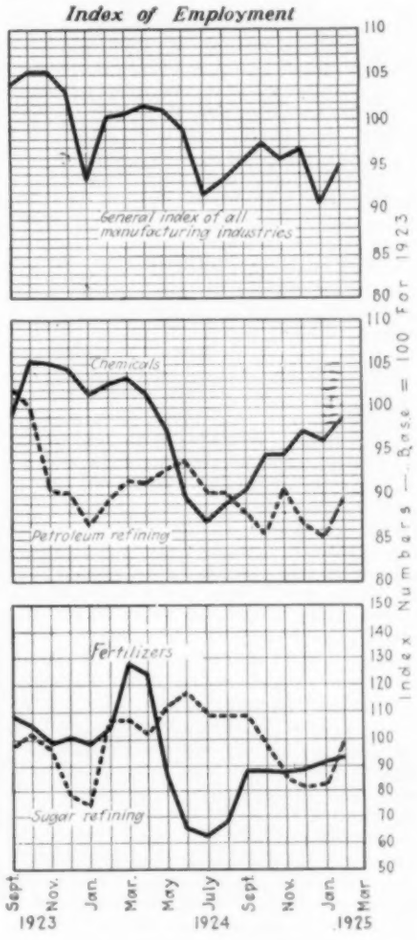
Increases in February over January prices are shown for the groups of fuels and building materials. In the fuel group very strong advances were recorded for gasoline and crude petroleum. These influences lifted the index number for the group 5½ per cent above the January level. Building materials, due to increases in southern yellow pine lumber, averaged 2 per cent higher than in January.

Of the 404 commodities or prices for which comparable data for January and February were collected, increases were shown in 108 instances and decreases in 127 instances. In 169 instances no change in price was reported.

Volume of Production


Raw materials
Manufactured goods
Chemicals, oil, etc.
Textiles
Index Numbers — Base = 100 For 1919
Sept. Nov. Jan. Mar. May July Sept. Nov. Jan. Mar
1923 1924 1925

Index of Employment


General index of all manufacturing industries
Chemicals
Petroleum refining
Fertilizers
Sugar refining
Index Numbers — Base = 100 For 1923
Sept. Nov. Jan. Mar. May July Sept. Nov. Jan. Mar
1923 1924 1925

Wholesale Prices

Department of Labor Indexes (Relative to 1913)

Fuels
All commodities
Chemicals
Metals
Index Numbers
May July Sept. Nov. Jan. Mar. May July Sept. Nov. Jan. Mar. May July Sept. Nov. Jan. Mar. May July Sept. Nov. Jan. Mar. May July Sept. Nov. Jan. Mar.
1920 1921 1922 1923 1924 1925

Market Conditions and Price Trends

Bromine and Methanol Developments Feature Chemical Market

Demand for Bromine Has Outgrown Ordinary Sources of Supply—Synthetic Methanol Threatens Existence of the Wood Product Industry

UNUSUAL conditions have arisen in the markets for methanol and bromine. Reference has been made at intervals, since last November, to the possible invasion of synthetic methanol from Germany. At first the extent of such competition was not fully understood. Information is now at hand which establishes that importations have assumed fairly large proportions, that buyers have placed long term contracts, that production costs are so low as to preclude competition from domestic makers of methanol from wood distillation. In short a long founded domestic industry is threatened either with total extinction or with a greatly reduced scale of operation.

Developments in the market for bromine are of a more encouraging nature. They are based on an expansion in the consuming end of the industry which makes it necessary to develop new sources of supply. Recent research work has developed a method of extracting bromine from sea water. This method soon will be tried out on a commercial scale. While it is reported that bromine can be obtained from sea water at low cost, the fact that a ready market awaits any increase in production, gives assurance of stable conditions, and producers are not worried over the prospect of enlarged outputs.

Generally speaking demand for chemicals has not been active. Contract deliveries continue to take large amounts into consuming trades but new business is hardly up to expectations and in some industries there has been a tendency to cut down requirements of raw materials.

Fertilizer interests have been interested in reports of probable advances in prices for potash salts. These reports were set at rest by receipt of a cable from Germany announcing an unchanged price list for potash salts for delivery in the coming year. Manure salts offered an exception to the general list as the new prices for the former are higher than have been prevailing.

Coincident with the announcement of the new prices for potash salts, was a statement from the Department of the Interior stating that permits and leases to mine potash on the public land domains, total 483, covering 1,092,873 acres. Terms of the potash permits and leases provide for an initial investment of about $2,926,000 and the payment of royalty to the government.

The probable extent of boll weevil infestation in the cotton growing area is looming up as a market factor. Manufacturers of calcium arsenate have worked off some of their surplus stocks but have not found much to encourage a resumption of production on a normal scale. Reports issued by the Bureau of Entomology have indicated a heavy weevil emergence which foretell serious damage to the cotton crop unless restrictive measure are adopted by planters. The lack of stability to prices for arsenate, however, show that buyers are waiting further developments and also demonstrate that the industry has not yet recovered from the depression of last season.

Leading Market Developments During the Month

Bleaching powder reduced in price for first time since latter part of 1923.

Increased consuming needs stimulate research to enlarge domestic supply of bromine.

Arrivals of synthetic methanol and reports that production will be started in this country, depress wood distillation industry.

Chlorates expected to advance in price following report of Tariff Commission in which increase in import duty was recommended.

President has taken no action in linseed oil tariff case and no change in duty seems imminent.

Germany raises prices for lower grade potash salts with muriate and sulphate unchanged.

Bromine Production Larger

The increased consumption of bromine, either as such or in the form of bromides, in the mineral oil industry has acted as a spur to production and domestic factors not only have increased their outputs but are trying to bring about still larger increases. An important recent development consisted in experimental work to recover bromine from salt water. As the result of preliminary efforts, a vessel has been equipped to function as a floating factory in an endeavor to obtain bromine from the ocean. Results from this venture soon will be known and if successful, an appreciable gain will be recorded in the domestic supply. Consumption of bromine in 1922 is estimated at slightly more than 1,000,000 lb. This estimate is based on a report of sales as made by the Geological Survey. This report stated that total sales amounted to 1,005,174 lb. and imports that year were but 1,094 lb. The Survey also stated that a large part of the output is not sold as bromine but in the form of potassium and sodium bromides and other salts and the total given for 1922 included the bromine content of the salts.

Imports of bromine never have been heavy but recent developments in consuming trades have made it necessary to turn to foreign countries and good sized orders are reported to have been placed with Germany for delivery over all of 1925. Price has not been so important as obtaining sufficient supplies. Incidentally the steps taken to increase domestic outputs even if successful are not expected to have any immediate effect on values as the increased supply would pass direct to consumers and would not compete with offerings which might be on the market.

Methanol Unsettled

The appearance of synthetic methanol on the market has created a situation which is unusual inasmuch as it is difficult to see how producers of the wood distillation product can carry on in the face of competition from abroad and from home producers if reports prove true that synthetic methanol will be turned out in this country. Latest available figures show an output of 542,397 gal. of methanol for February and stocks on hand on March 1, 1,365,830 gal. Private reports credit a falling off in production since then and considerable speculation has been indulged in regarding the future for acetate of lime, acetone, acetic acid, and formaldehyde.

Reports vary regarding the amount of German methanol which has been sold for delivery to this country. It is generally conceded that some large contracts have been placed but it is also stated that surplus offerings are not large at present and that this is holding down the volume of sales. Production costs in Germany are said to be as low as 18c. per gal. and if this approximates the truth the impossibility of successful competition from wood alcohol is apparent.

Decline in Bleaching Powder

Outside of infrequent rumors of price cutting the market for bleaching powder held a steady position throughout 1924 and this condition continued up to the past month. Production of bleach has been held in check but stocks at producing points were fairly large. In spite of this producers held the market on an even keel and there was no indication that the stability of values would be shaken. At present the representative of one of the so-called independent producers is offering bleaching powder at $1.80 per 100 lb. at works. As the product of this maker is admitted to be up to standard, this figure may be taken as the market value. Some reports have been current that this quotation has been met in other directions and the market is somewhat unsettled with uncertainty about what some large producers will do to protect themselves against the lower priced sellers.

Market Conditions and Price Trends

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This month	**112.60**
Last month	113.16
April, 1924	116.31
April, 1923	126.45

Lower prices for bleaching powder, sulphate of ammonia, prussiate of soda, and metal salts brought the weighted index number to the lowest level of the year. Price shading in many other selections is in line with the general trend.

Sulphuric Acid Surplus

While deliveries against contracts have taken up large amounts of acid, new buying has not been heavy enough to keep pace with production and accumulations at some works have hung over the market and weakened values. Sales were made at private terms in recent weeks and prices actually paid were far below the levels openly quoted. Round lots of 66 deg. acid are said to have changed hands as low as $10.50 per ton, f.o.b. works. The market is influenced by a preponderance of stocks and future values depend largely on the placing of supply and demand on a closer parity.

Higher Duty for Chlorates

The Tariff Commission has reported to the President in favor of a 50 per cent increase in the import duty on chlorates. With chlorate of potash receiving the greater part of interest, the increase in duty will place the foreign-made product under a handicap of 2¼c. per lb. The importance of this change may be seen from the fact that imported chlorate of potash has been supplying about 90 per cent of domestic requirements. Annual needs are estimated at about 5,000 tons. Last year imports amounted to more than 5,000 tons, and while unsold stocks were in evidence it is apparent that the bulk of consuming wants was taken care of by the imported material. Recent imports have been large, influenced, no doubt, by the belief that a higher duty was in prospect. Should the maximum duty of 2¼c. per lb. become effective, domestic chlorate would be able to compete more favorably and the home output undoubtedly would be increased materially. The capacity of domestic plants is more than sufficient to supply all needs.

Nitrate of Soda Steady

Advices from Chile state that there is no chance for any decline in the prices quoted for nitrate of soda for delivery in the present nitrate year. Producers, however, are disturbed by fears of competition from producers of synthetic nitrate and they are attempting to have the export tax on nitrate reduced in Chile so as to give consumers the benefit of a lower price and also to stimulate consumption in the United States. There were 92 oficinas in operation in February and production amounted to 182,000 tons. Shipments in the first half of March amounted to 105,000 tons of which 85,000 tons were for the United States. Imports into this country for the 8 months ended February were 561,101 tons as compared with 651,785 tons in the corresponding period last year.

Vegetable Oils Slow

Consumers, as a rule, were not active buyers of vegetable oils in the past month and values for the latter responded by seeking lower levels. Imports of oils have been running heavy and the fact that many consumers were covered ahead no doubt had much to do with the slower inquiry. Palm kernel oil has been used in larger quantities than ever before which is said to be due more to cost considerations than to any new outlets. Consumption of China wood oil also has been heavy in spite of the rapid increase in use of lacquers but buyers became reserved as values started to become easier.

Linseed Oil Duty Unchanged

It had been generally expected that the President would announce a decline in duty on linseed oil shortly after receiving the report of the Tariff Commission which recommended such action. No definite action, however, has been taken and the delay in coming to a decision has prompted the belief that the present duty will be allowed to stand. Prices for linseed oil in the past month have been going in buyers' favor. Expectation of tariff action is said to have started a decline in the market and later on the flax market followed the slump in grains and values for oil were marked down to conform with the position of seed. Preliminary reports indicated a slight falling off in the flax acreage this season but the decline in wheat and other grains may change intentions of growers and at any rate it is too early to place any reliance on such reports as seeding will not be completed until well along in June. Argentine threshings indicated a larger yield than had been estimated and the statistical position of seed would not warrant any drastic movement to values for either seed or oil.

Cotton Oil Irregular

Crude oil has not varied much in position but the refined market has shown a tendency to follow other markets and has shown the results of a speculative following. Disappearance of refined oil in February was estimated at 228,000 bbl. and private figures for March consumption would indicate a still higher movement. The statistical situation, however, is still in favor of buyers. The supply for the last 5 months of the crop year is placed at approximately 1,900,000 bbl., based on the last report on seed and oil stocks. With due allowance for a large carryover, an average monthly consumption of 280,000 bbl. would be available. The supply on March 1 was shown as follows:

	Bbl.
Refined Oil Stocks	872,000
Crude Oil Stocks	292,000
Seed on Hand	418,000
Seed to Come	295,000
	1,877,000

In the above compilation crude oil and seed are given in their equivalent of refined oil.

Export trade in cottonseed oil is not a factor and the price structure of the present market is built around the position of lard with values predicated on the relative values of lard and oil with the expectation that sales of compound will take up the surplus supply of oil and justify the market. With warm weather and the new cotton crop approaching the stability of the oil market is open to serious doubt and the large amount of speculative oil to be liquidated in July and September is decidedly against a maintenance of present prices.

Chem. & Met. Weighted Index of prices for Oils and Fats

Base = 100 for 1913-14

This month	**154.01**
Last month	161.32
April, 1924	127.53
April, 1923	157.33

The general tendency of values was downward but earlier losses were partly recovered following a stronger market for cottonseed oil. Linseed, coconut, castor, china wood, and palm oils closed below last month's levels.

Exports of Chemicals

	Feb., 1925	Feb. 1924
Benzol, lb	4,440,062	770,277
Aniline Oil and Salts, lb	189,503	31,415
Acid, Acetic, lb	55,157	36,539
Acid, Boric, lb	63,423	53,371
Acid, Sulphuric, lb	940,108	848,933
Methanol, gal	39,625	120,489
Aluminum Sulphate, lb	3,002,611	2,250,605
Acetate of Lime, lb	999,374	1,118,977
Calcium Carbide, lb	199,373	837,482
Bleaching Powder, lb	1,264,724	2,071,947
Copper Sulphate, lb	223,531	502,505
Formaldehyde, lb	144,056	257,584
Potash, Bichromate, lb	44,869	149,310
Sodium, Bichromate, lb	758,537	
Sodium, Cyanide, lb	162,895	960,380
Borax, lb	2,766,523	2,522,881
Soda Ash, lb	2,967,346	1,803,668
Sodium Silicate, lb	2,451,503	1,824,756
Sal Soda, lb	913,154	1,257,444
Caustic Soda, lb	7,799,465	7,814,591
Sulphate of Ammonia, ton	6,651	11,727

Imports of Chemicals

	Feb., 1925	Feb., 1924
Naphthalene, lb	110,743	1,611,746
Pyridine, lb	25,251	32,326
Arsenic, lb	1,589,132	1,545,024
Acid, Citric, lb	30,800	183,120
Acid, Formic, lb	133,782	266,638
Acid, Oxalic, lb	248,981	473,877
Acid, Sulphuric, lb	1,186,512	2,594,345
Acid, Tartaric, lb	402,139	374,444
Ammonia, Chloride, lb	1,456,482	1,081,931
Ammonia, Nitrate, lb	318,000	370,852
Barium Compounds, lb	1,553,174	844,991
Calcium Carbide, lo	1,047,880	693,900
Copper Sulphate, lb	20,000	600,224
Potassium, Cyanide, lb	15,377	272,513
Potassium, Carbonate, lb	971,201	451,121
Potassium, Hydroxide, lb	905,672	1,356,229
Potassium, Chlorate, lb	1,340,832	934,973
Sodium, Cyanide, lb	1,842,100	2,309,353
Sodium, Ferrocyanide, lb	145,690	229,490
Sodium Nitrite, lb	257,908	337,441
Sodium, Nitrate, ton	95,109	149,603
Sulphate of Ammonia, ton	5,617	379

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. producing points, the quotations are given on that basis and are so designated. Prices for the corresponding period last month and last year are included for comparative purposes. Prices are corrected to April 11.

Industrial Chemicals

		Current Price	Last Month	Last Year
Acetone, drums	lb.	$0.10 –$0.11	$0.10 –$0.11	$0.16 –$0.17
Acid, acetic, 28%, bbl.	cwt.	3.12 – 3.37	3.12 – 3.37	3.37 – 3.62
Boric, bbl.	lb.	.10½– .10¾	.10½– .10¾	.10 –
Citric, kegs	lb.	.45½– .47	.46 – .47	.46½– .48
Lactic, 44%, tech., light, bbl.	lb.	.13½– .14	.13½– .14	.12½– .13
22% tech., light, bbl.	lb.	.06½– .07	.06½– .07	.06 – .06½
Muriatic, 18° tanks	cwt.	.80 – .85	.80 – .85	.80 – .85
Nitric, 36°, carboys	cwt.	.04¼– .04½	.04 – .04¼	.04 – .04½
Oxalic, crystals, bbl.	lb.	.10¾– .11	.10¾– .11	.10¾– .11
Sulphuric, 60°, tanks	ton	8.50 – 9.50	8.50 – 9.50	9.00 –10.00
Tartaric, powd., bbl.	lb.	.28 – .30	.27½– .29	.27– .30
Alcohol, ethyl, 190 p'f. U.S.P. bbl.	gal.	4.90 –	4.89 –	4.81 –
Alcohol, denatured, 190 proof No. 1 special dr.	gal.	.60½–	.60½–	.45½–
No. 5, 188 proof, dr.	gal.	.59½–	.54 –	.44½–
Alum, ammonia, lump, bbl.	lb.	.02½– .04	.03½– .04	.03½– .04
Potash, lump, bbl.	lb.	.03¼– .03½	.03¼– .03½	.03¼– .03½
Aluminum sulphate, com., bags	cwt.	1.40 – 1.45	1.40 – 1.45	1.40 – 1.50
Aqua ammonia, 26°, drums	lb.	.06½– .06¾	.06½– .06¾	.06½– .06¾
Ammonia, anhydrous, cyl.	lb.	.30 – .32	.30 – .32	.28 – .30
Ammonium carbonate, powd. tech., casks	lb.	.07¾– .08	.07¾– .08	.12 – .13
Ammonium nitrate, tech., casks	lb.	–	–	.09 – .10
Ammonium sulphate, wks.	cwt.	2.75 – 2.85	2.75 – 2.85	2.85 –
Amylacetate tech., drums	gal.	2.75 – 3.25	3.25 – 3.50	3.50 – 4.00
Arsenic, white, powd., bbl.	lb.	.05 – .05½	.05½– .05¾	.10½– .11
Arsenic, red, powd., kegs	lb.	.13 – .13½	.13½– .14	.15 – .15½
Barium carbonate, bbl.	ton	52.00 –56.00	52.00 –58.00	67.00 –68.00
Barium chloride, bbl.	ton	62.00 –70.00	66.00 –70.00	85.00 –90.00
Barium, nitrate, casks	lb.	.07½– .08	.07¾– .08	.08 – .08½
Bleaching powder, f.o.b. wks., drums	cwt.	1.80 – 2.00	2.00 – 2.10	1.75 –
Borax, bbl.	lb.	.05 – .05½	.05 – .05½	.05½– .05¾
Calcium acetate, bags	cwt.	3.00 – 3.05	3.00 – 3.05	3.50 – 3.55
Calcium arsenate, dr.	lb.	.07 – .07½	.07½– .08	.11 – .11½
Calcium carbide drums	lb.	.05 – .05½	.05 – .05½	.05 – .05¾
Calcium chloride, fused, dr. wks.	ton	21.00 –	21.00 –	21.00 –
Carbon bisulphide, drums	lb.	.06 – .06½	.05½– .06	.06 – .06½
Carbon tetrachloride drums	lb.	.07 – .07½	.07 – .07½	.07½– .08
Chlorine, liquid, tanks, wks.	lb.	.04½–	.04½–	.04 – .04½
Copperas, bbls., f.o.b. wks.	ton	15.00 –16.00	16.00 – 18.00	16.00 –18.00
Copper carbonate, bbl.	lb.	.16½– .17	.17½– .17¾	.18 – .18½
Copper sulphate, bbl.	cwt.	4.65 – 4.85	4.65 – 4.85	4.50 – 4.85
Cream of tartar, bbl.	lb.	.22 – .22	.21 – .21½	.22½– .23
Epsom salt, dom., tech., bbl.	cwt.	1.75 – 2.00	1.75 – 2.00	1.75 – 2.00
Epsom salt, imp., tech., bags.	cwt.	1.25 – 1.30	1.25 – 1.30	1.10 – 1.15
Ethyl acetate, 85% drums	gal.	.87 – .90	.92 – .95	1.00 – 1.10
Formaldehyde, 40%, bbl.	lb.	.09 – .09½	.09 – .09½	.11 – .11½
Fusel oil, crude, drums	gal.	2.70 – 3.00	2.70 – 3.00	2.50 – 2.75
Glaubers salt, bags	cwt.	.85 – 1.40	.85 – 1.40	.95 – 1.40
Glycerine, c.p., drums, extra	lb.	.18½– .18¾	.19 – .19½	.17 – .17½
Lead: White, basic carbonate, dry, casks	lb.	.10½–	.11½–	.10½–
White, basic sulphate, csk	lb.	.10½–	.11 –	.09½–
Lead acetate, white crys., bbl.	lb.	.15½– .16	.15½–	.15 –
Lead arsenate, powd., bbl.	lb.	.15½– .16	.15½– .16	.18 –
Lithopone, bags	lb.	.06 – .06½	.06 – .06½	.06½– .06¾
Magnesium carb., tech., bags.	lb.	.06½– .07	.06¾– .07	.08½– .08¾
Methanol, 95%, dr.	gal.	.68 – .70	.70 – .72	.93 –
Methanol, 97%, dr.	gal.	.70 – .72	.72 – .74	.95 –
Nickel salt, double, bbl.	lb.	.09 – .10	.09 – .10	.09½– .10
Nickel salts, single, bbl.	lb.	.10 – .11	.10 – .11	.10½– .11
Phosphorus, red, cases	lb.	.68 – 1.00	.68 – 1.00	.70 – .75
Phosphorus, yellow, cases	lb.	.35 – .40	.32 – .35	.35 – .40
Potassium bichromate, casks	lb.	.08½– .08¾	.08½– .08¾	.09¾– .09¾
Potassium carbonate, 80-85%, calcined, casks	lb.	.06 – .06½	.06 – .06½	.06½– .06¾
Potassium chlorate, powd.	lb.	.07½– .08	.07 – .08	.07½– .08½
Potassium hydroxide (caustic potash) drums	lb.	.07½– .07¾	.07½– .07¾	.06½– .06¾
Potassium muriate, 80% bgs	ton	34.55 –	34.55 –	34.55 –
Potassium nitrate, bbl.	lb.	.06 – .07½	.06 – .07¾	.07½– .09
Potassium permanganate, drums	lb.	.14½– .15	.14 – .14½	.14 – .14½
Potassium prussiate, yellow, casks	lb.	.18 – .18½	.18 – .18½	.19 – .19½
Salammoniac, white, casks	lb.	.05½– .07	.05½– .07	.06½– .08
Salsoda, bbl.	cwt.	1.20 – 1.40	1.20 – 1.40	1.20 – 1.40
Soda ash, light, 58% bags, contract	cwt.	1.25 –	1.25 –	1.25 –
Soda, caustic, 76%, solid, drums, contract	cwt.	3.10 –	3.10 –	3.10 –
Sodium acetate, works, bbl.	lb.	.05½– .06	.05½– .05¾	.05 – .05½
Sodium bichromate, casks	lb.	.06½– .06¾	.06½– .06¾	.07½– .07¾
Sodium chlorate, kegs	lb.	.06½– .07	.06½– .06¾	.06½– .07
Sodium cyanide, cases, dom.	lb.	.18 – .22	.18 – .22	.19 – .22
Sodium fluoride, bbl.	lb.	.09 – .09½	.09 – .09½	.09 – .10½
Sodium nitrate, bags	cwt.	2.65 – 2.67	2.65 – 2.67	2.55 –
Sodium nitrite, casks	lb.	.09 – .09½	.09 – .09¼	.08¾– .08¾
Sodium phosphate, dibasic, bbl.	lb.	.03½– .03¾	.03½– .03¾	.03½– .03¾
Sodium prussiate, yel. drums	lb.	$0.09¾–$0.10	$0.10 –$0.10½	$0.10½– .11
Sodium silicate (30°, drums)	cwt.	.75 – 1.15	.75 – 1.15	.75 – 1.15
Sodium sulphide, fused, 60–62% drums	lb.	.02½– .03½	.02½– .03½	.03¼– .03½
Sodium sulphite, crys., bbl.	lb.	.03½– .03¾	.03½– .03¾	.03½– .03¾
Sulphur, crude at mine, bulk	ton	14.00 –16.00	14.00 –16.00	16.00 –18.00
Sulphur, flour, bag	cwt.	2.35 – 3.00	2.35 – 3.00	2.25 – 2.35
Tin bichloride, bbl.	lb.	.15½–	.16 –	.15½– .16
Tin oxide bbl.	lb.	.61 –	.61 –	.60 –
Tin crystals, bbl.	lb.	.39 –	.39½– .40	.39 – .39½
Zinc chloride, gran., bbl.	lb.	.06½– .07½	.06½– .07½	.05 – .05½
Zinc oxide, lead free, bag	lb.	.07½–	.07½–	.07½–
5% lead sulphate, bags	lb.	.06¼–	.06¼–	.07½–
Zinc sulphate, bbl.	cwt.	3.00 – 3.50	3.00 – 3.50	3.00 – 3.25

Oils and Fats

		Current Price	Last Month	Last Year
Castor oil, No. 3, bbl.	lb.	$0.16½–$0.16¾	$0.17 –$0.17½	$0.15 –
Chinawood oil, bbl.	lb.	.13 – .13¼	.14 – .14½	.14 – .15
Coconut oil, Ceylon, tanks, N. Y.	lb.	.09½–	.10¼–	.08½–
Corn oil, crude, tanks, (f.o.b. mill)	lb.	.10½–	.10½–	.09 –
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.09½–	.10 –	.08 – .08¾
Linseed oil, raw, car lots, bbl.	gal.	1.06 –	1.14 –	.90 –
Palm, Lagos, casks	lb.	.09½–	.09¾–	.07½–
Niger, casks	lb.	.08½–	.09 –	.06½–
Peanut oil, crude, tanks (mill)	lb.	.11¼–	.11 – .11½	.11½–
Rapeseed oil, refined, bbl.	gal.	.98 – .99	.90 – .91	.92 – .94
Sesame, bbl.	lb.	.15 – .15½	.14½– .14¾	.11½–
Soya bean tank (f.o.b. Coast)	lb.	.10½–	.11 – .11½	.10½– .10¾
Sulphur (olive foots), bbl.	lb	.09½– .09¾	.09½– .09¾	.09½– .10
Cod, Newfoundland, bbl.	gal.	.62 – .63	.62 – .63	.64 – .66
Menhaden, light pressed, bbl.	gal.	.72 – .75	.72 – .75	.60 –
Crude, tanks (f.o.b. factory)	gal.	.55 –	.55 –	.47½–
Grease, yellow, loose	lb.	.08¼– .09	.08¼– .08¾	.06½– .07
Oleo stearine	lb.	.11 – .11½	.10¾–	.09¾–
Red oil, distilled, d.p. bbl.	lb.	.11½– .11¾	.09 – .09½	.08¼– .08¾
Tallow, extra, loose	lb.	.09½– .09¾	.09½– .09¾	.07½–

Coal-Tar Products

		Current Price	Last Month	Last Year
Aniline oil, drums, extra	lb.	$0.16 –$0.16½	$0.16 –$0.16½	$0.16 –$0.16½
Aniline salts, bbl.	lb.	.20 – .22	.20 – .22	.22½– .23
Anthracene, 80%, drums	lb.	.65 – .70	.65 – .70	.75 – .80
Benzol, 90%, tanks, works	gal.	.22 –	.21 –	.23 –
Beta-naphthol, tech., drums	lb.	.24 – .25	.24 – .25	.25 –
Cresylic acid, 97%, drums, works	gal.	.59 – .62	.59 – .62	.68 – .72
Naphthalene, flake, bbl.	lb.	.05 – .05½	.05 – .05½	.05½– .06
Phenol, U.S.P., drums	lb.	.23 – .25	.23 – .25	.26 – .29
Picric acid, bbl.	lb.	.25 – .26	.25 – .26	.20 – .22
Resorcinal, tech., kegs	lb.	1.30 – 1.40	1.30 – 1.40	1.30 – 1.40
Salicylic acid, tech., bbl.	lb.	.33 – .34	.33 – .34	.32 – .33
Solvent naphtha, w.w., tanks	gal.	.25 –	.25 –	.25 –
Toluene, tanks, works	gal.	.26 –	.26 –	.26 –
Xylene, com., tanks	gal.	.25 – .26	.25 – .26	.28 –

Miscellaneous

		Current Price	Last Month	Last Year
Barytes, grd., white, bbl.	ton	$17.00–$17.50	$17.00–$17.50	$16.00–$17.00
Casein, tech., bbl.	lb.	.13 – .14	.13 – .14	.11½– .12
China clay, powd., f.o.b. Ga.	ton	12.00– 15.00	12.00 –15.00	14.00 –20.00
Imported, pwd.	ton	45.00 –50.00	45.00 –50.00	45.00 –50.00
Dry colors: Carbon gas, black (f.o.b. works)	lb.	.06½– .08½	.06½– .08½	.07½– .09
Lamp black, bbl.	lb.	.12 – .40	.12 – .40	.12 – .40
Prussian blue, bbl.	lb.	.35 – .37	.35 – .37	.40 – .43
Ultramarine blue, bbl.	lb.	.08 – .35	.08 – .35	.08 – .35
Sienna, Italian, bbl.	lb.	.04 – .12	.04 – .12	.06 – .14
Umber, Turkey, bbl.	lb.	.04 – .04½	.04 – .04½	.04 – .04½
Chrome green, bbl.	lb.	.27 – .29	.29 – .31	.28 – .30
Carmine red, tins	lb.	4.25 – 4.50	4.25 – 4.50	4.50 – 4.70
Para toner	lb.	.90 – .95	.90 – .95	1.00 – 1.10
Vermilion, English, bbl.	lb.	1.40 – 1.45	1.40 – 1.45	1.15 – 1.20
Chrome yellow, C. P., bbl.	lb.	.18½– .19	.19½– .20½	.16½– .17½
Ocher, French, casks	lb.	.02 – .03	.02 – .03	.02½– .03
Feldspar, No. 1 (f.o.b. N. C.)	ton	6.50 – 7.25	6.50 – 7.25	6.50 – 7.00
Graphite, Ceylon, lump, bbl	lb.	.07 – .07½	.07 – .07½	.05½– .06
Gum copal, Congo, bags	lb.	.08 – .09½	.08¼ – .10	.10 – .15
East Indian, bags	lb.	.14 – .15	.14 – .15	.20 – .21
Manila, bags	lb.	.14 – .16	.14 – .16	.19 – .20
Damar, Batavia, cases	lb.	.28 – .28½	.28 – .28½	.23½– .24
Kauri, No. 1 cases	lb.	.60 – .65	.60 – .65	.64 – .66
Kieselguhr (f.o.b. N. Y.)	ton	50.00 –55.00	50.00 –55.00	50.00 –55.00
Magnesite, calc.	ton	35.00 –42.00	35.00 –42.00	35.00 –40.00
Pumice stone, lump, bbl.	lb.	.06 – .08	.06 – .08	.05 – .05½
Imported, casks	lb.	.03 – .40	.03 – .40	.03 – .35
Pyrites, Span., fines, cif.	unit	.11½– .12	.11½– .12	.10 – .10½
Domestic, fines (f.o.b. Ga.)	unit	.12 –	.12 –	.10½– .11
Shellac, orange, fine, bags	lb.	.66 – .68	.64 – .65	.59 –
Bleached, bonedry, bags	lb.	.67 – .69	.71 – .73	.66 – .67
T. N., bags	lb.	.58 – .59	.62 – .63	.56 – .57
Soapstone (f.o.b. Vt.), bags	ton	7.00 – 7.50	7.00 – 7.50	7.50 – 8.00
Talc, 200 mesh (f.o.b. Vt.)	ton	10.50 –	10.50 –	10.00 –
200 mesh (f.o.b. Ga.)	ton	7.50 –10.00	7.50 –10.00	8.00 –12.00
325 mesh (f.o.b. N. Y.)	ton	14.75 –	14.75 –	14.75 –
Wax, Bayberry, bbl.	lb.	.21 – .22	.21 – .22	.25 – .26
Beeswax, ref., light	lb.	.45 – .49	.50 – .52	.32 – .34
Candellila, bags	lb.	.30 – .31	.30 – .31	.23 – .23½
Carnauba, No. 1, bags	lb.	.35 – .37	.36 – .37	.37 – .38
Paraffine, crude 105–110 m.p.	lb.	.06½– .06¾	.06½– .06¾	.05 –

Current Industrial Developments

New Construction and Machinery Requirements

Outstanding Opportunities

Aluminum	Hamden, Conn.
Disinfectants	Cleveland, O.
Fertilizer	Newington, Conn.
Fibersilk	Jacksonville, Tenn.
Fire brick	Salina, Pa.
Galvanizing	Chicago, Ill.
Water Gas	Iron Mountain, Mich.
Gas	Toronto, Ont.
Oil	Fort Worth, Tex.
Oil	Boynston, Okla.
Paint	St. Louis, Mo.
Paper	Woronoco, Mass.
Paper	Richmond, Va.
Paper	Joliet, Ill.
Pottery	Niles, O.
Pulp	Kagawong, Ont.
Pulp	Bromptonville, Que.
Rubber	Cambridge, Mass.
Sugar	Sacramento, Calif.
Syrup	Fresno, Calif.

This page is of value not only as a machinery market but also as an index of the general activity and growth of the industries served by Chem. & Met. The reports are gathered by our regular correspondents who are instructed to verify every detail. Requirements for new machinery will be published here free of charge.

New England

Conn., Hamden — United Smelting & Aluminum Co., Edmond St., awarded contract for the construction of a 110 x 140 ft. factory, to L. Edgar, 17 White St. Estimated cost $40,000. Mill equipment will be required.

Conn., Newington — Connecticut Fat & Fertilizer Co., awarded contract for the construction of a 40 x 75 ft. fertilizer factory, to Lawrence & Coe Construction Co., 372 Trumbull St., Hartford.

Mass., Cambridge (Boston P. O.)—Cambridge Rubber Co., 748 Main St., is having plans prepared for the construction of a 4 story, 80 x 100 ft. factory, at Main and Windsor Sts. J. R. Worcester & Co., 70 Milk St., Boston, are architects.

Mass., Chelsea (Boston P. O.)—Panco Rubber Co., Highland St., is receiving bids for the construction of a 50 x 60 ft. factory addition, on Highland St. Schein & Levine, 508 Pemberton St., Boston, are architects.

Mass., Clinton—W. W. Russell, 77 Franklin St., Boston, will build a water gas plant here, by day labor. Estimated cost $40,000. E. L. Rawson, 6 Beacon St., Boston, is architect.

Mass., North Adams—North Adams Gas & Electric Co., B. K. Cook, Mgr., awarded contract for the construction of a water gas plant, to J. R. Hampson, 184 North St., Pittsfield. Estimated cost $40,000.

Mass., Watertown (Boston P. O.)—Hood Rubber Co., awarded contract for the construction of three buildings, with total of 90,000 sq.ft., for plant additions, to Aberthaw Co., 27 School St., Boston.

Mass., Weston—Fuelite Natural Gas Co. of New England, 1441 Beacon St., Brookline, will build a 2 story, 50 x 100 ft. factory, garage and office at plant here, by day labor. Estimated cost $40,000. Private plans.

Mass., Worcester—G. C. Whitney, Union and School Sts., awarded contract for the construction of a 3 story addition to paper plant, to Aberthaw Construction Co., 27 School St., Boston. Estimated cost $60,000.

Mass., Woronoco—Strathmore Paper Co., will soon award contract for the construction of a 4 story, 41 x 200 ft. paper mill addition. Estimated cost $200,000. Equipment will be installed. Company engineer in charge.

Middle Atlantic

Md., Canton (Baltimore P. O.)—Lockwood, Greene & Co., 100 East 42nd St., New York City, Engrs. and Archts., will receive bids until April 15th, for the construction of 2 and 3 story, plant, for the Gold Dust Corporation, 239 West 30th St., New York City. Estimated cost $1,000,000.

N. J., Trenton—Trenton Potteries Co., awarded contract for the construction of a 4 story, 50 x 101 ft. warehouse, to S. W. Mather & Sons, Greenwood Ave. $50,000. W. A. Kleeman, First National Bank Bldg., is engineer.

N. Y., Buffalo—Acme Builders Supply Co., 2675 Main St., plans the construction of plaster mills, on a 100 x 263 ft. site, recently purchased on Breckenridge. Estimated cost $75,000.

Pa., Moore—Alloy Metal Wire Co., is in the market for electric induction melting furnace, 500 lb. capacity per heat.

Pa., Salina—Kier Fire Brick Co., Oliver Bldg., Pittsburgh, is having plans prepared for the construction of a clay calcining plant, with 35 ton per day capacity in Westmoreland County, near here. Estimated cost $50,000. Schaffer Engineering Co., 800 House Bldg., Pittsburgh.

Pa., Zelinople—Atlas Sanitary Manufacturing Co., plans the construction of a group of 4 buildings, including foundry, cleaning building, enamel shop and shipping building. Estimated cost $100,000. Private plans.

South

Fla., Brandentown—City, will receive bids in about 60 days, for the construction of an 800,000 ft. gas plant. J. B. McCrary Engineering Corp., Atlanta, Ga., is engineer.

Ga., Macon—Dixie Fireproofing Co., W. P. Stevens, Pres., plans the construction of a plant for the manufacture of fire brick. Estimated cost $100,000. Sites at Gordon and Macon are under consideration.

N. C., New Bern—New Bern Cotton Oil & Fertilizer Mills, plans to build mill here, to replace fire loss.

Tenn., Jacksonville—Du Pont Fibersilk Co., Wilmington, Del. H. J. White, Gen. Supt. plans the construction of 2 additional units, for the manufacture of fiber silk, at plant here. Estimated cost $2,750,000.

Va., Richmond—Albemarle Paper Manufacturing Co., Tredgr St., B. W. Coale, Treas., plans the construction of a 4 story addition to plant. Estimated cost $200,000. Equipment will be required.

Va., Richmond—McAdoo Rubber Wks., Randall and Westover Aves., G. W. Booth, is in the market for a small calender for rubberizing fabrics (new or used).

Va., Winchester—National Fruit Product Co., plans to rebuild vinigar factory to replace fire loss. Estimated cost $75,000.

Middle West

Ill., Alton—Illinois Glass Company of Alton, awarded contract for the construction of a 130 x 1,000 ft. warehouse, also several other buildings, to Morton C. Tuttle Co., 862 Park Square Bldg., Boston.

Ill., Chicago—Holmquist Tire & Vulcanizing Co., 6712 South Ashland Ave., A. Holmquist, Pur. Agt., is in the market for vulcanizing equipment, small tools, and repair equipment.

Ill., Chicago—Joslyn Manufacturing & Supply Co., Chamber of Commerce Bldg., M. L. Joslyn, Pres., awarded contract for the construction of a 130 x 230 ft. hot dip galvanizing plant as an addition to pole line materials plant, at 3700 South Morgan Ave. Estimated cost $250,000.

Ill., Chicago—John Michels, 1112 North California Ave., is in the market for brass foundry equipment, for new plant under construction.

Ill., Joliet — Standard Wall Paper Co., Hudson Falls, N. Y., awarded contract for the construction of a 1 and 2 story, addition to wall paper mill on East Washington St., here, to Austin Company, 160 North La Salle St., Chicago. Estimated cost $200,000.

Mich., Detroit—Unique Brass Manufacturing Co., 5450 West Jefferson Ave., awarded contract for the construction of a 60 x 125 ft. factory addition, at plant, to Everett Winters Co., 1024 Book Bldg.

Mich., Iron Mountain — Iron Mountain Gas Co., 214 West Water St., Milwaukee, Wis., W. T. Tibbs, Pres., is having plans prepared for the construction of a 2 story, water gas plant, here. Estimated cost $100,000. New gas holder and special machinery will be required. Gas Machinery Co., 1900 Euclid Ave., Cleveland, O., are engineers.

O., Cleveland—The George L. Williams Co., G. L. Williams, Pres., 1621 Johnson Ave., has had plans prepared for the construction of a 1 and 2 story, 50 x 125 ft. and 40 x 70 ft. plant for the manufacture of disinfectants, at 5700 Train Ave. Estimated cost $60,000. J. W. Lowell, c/o owner, is architect.

O., Cleveland—George Rackle & Sons Co., Stop 5, A. B. C. Line, G. Rackle, Pres., awarded contract for the construction of a 2 story, 75 x 260 ft. factory and pattern shop for the manufacture of art stone and cement tile, at plant, to Truscon Steel Co., 1030 Albert St., Youngstown. Estimated cost $100,000. Equipment, including a concrete mixer for plastic work will be required

O., Cleveland—City, W. K. Hoare, Pur. Agt., will receive bids until April 24 for sulphate of aluminum and liquid chlorine.

O., Dover — Penn Mold Manufacturing Co. plans the construction of a 77 x 160 ft. foundry for the manufacture of brass castings, for bushings and bearings from 1½ to 12 ft. Complete machinery will be required. Estimated cost $40,000. R. Pitt, Pur. Agt.

O., Niles—Atlas China Co., A. O. C. Ahrendts, Pres., plans the construction of a pottery, including 6 kilns, to replace fire loss. Estimated cost $200,000. Owners are in the market for clay shop equipment, including clay pressing machinery.

O., St. Bernard — Globe Chemical Co., Murray Rd., F. C. Grote, Pres., recently incorporated to facilitate increase in production, will soon be in the market for chemical apparatus for manufacture of sulphuric acid, nitric acid, and a storage battery acid. Storage tanks will also be required.

O., Zanesville—Standard Tile Co., will soon receive bids for the construction of an addition to plant, to contain two additional kilns at Noval Park, here. Estimated cost $50,000.

Wis., Frederic—Fame Canning Co., 111 West Washington St., Chicago, Ill., awarded contract for the construction of a 2 story, cannery, here, to Nyman Construction Co., Cumberland, Wis. Estimated cost $100,000.

Wis., Iron River—Iron River Packing Co., D. J. Fitzgerald, 722 Werle Ave., Mgr., will receive bids until April 15 for the construction of a 2 story, 42 x 80 ft. cannery. Estimated cost $60,000. Canning and conveying machinery will be required.

Wis., Kaukauna—Little Rapids Pulp Co., J. Shine, Mgr., is in the market for 2 pulp grinders, 2 wet machines, 90 kw. generator barkers, conveyors, etc. L. A. DeGuere, Wisconsin Rapids, is engineer.

Wis., Nasbro (Brownsville P. O.)—Western Lime and Cement Co., 68 Wisconsin St., Milwaukee, plans rebuilding of 2 story plant for the manufacture of lime for building purposes, here. Estimated cost $50,000. Special wood hydrating equipment will be required. Private plans.

Wis., Sturgeon Bay—Reynolds Preserving Co., awarded contract for the construction of two 40 x 100 ft. and 40 x 40 ft. canneries, with 20 x 40 ft. boiler house, at plant, here, to Default & Hirsch. Estimated cost $50,000. Canning machinery will be required.

Mo., St. Louis—Busy Bee Co., 417 North Seventh St., awarded contract for enlargement and alterations to candy factory to McKelvey Construction Co., 911 Title Guarantee Bldg. Estimated cost $10,000.

Mo., St. Louis—Phelan Faust Paint Mfg. Co., 1215 Pine St., awarded contract for the construction of 3 story, 36 x 143 ft. varnish factory, and a 36 x 56 ft. paint factory, on Loughborough St. to Kenton-Hercules Construction Co., 912 Wainwright Bldg.

Okla., Blackwell — Tredway Boiler & Welding Works will soon receive bids for the construction of a 50 x 75 ft. factory, for metal welding, electric arc, and oxy-acetylene and boiler making. Private plans.

Okla., Boynston — Transcontinental Oil Co., Muskogee, A. J. Slagter, Supt., will build an oil refinery here, by day labor. Plans include three 10 x 40 crude stills, with condenser boxes, tail house, etc., installation of a continuous treating system, and improvements and additions to present pipe still battery. A. G. Slagter, is engineer and architect.

Okla., Bristow—Transcontinental Oil Co., Muskogee, will build additions to oil refinery, here, by day labor. Plans include construction of 4 additional pressure stills, run down and bleacher tanks, and installation of continuous treating system, etc. A. J. Slagter, Gen. Supt. is architect and engineer.

Okla., Ponca City — Maryland Refining Co., awarded contract for the construction of a 2 story, 60 x 114 ft. laboratory and office building, to R. McCormick, Ponca City. Estimated cost $100,000.

Tex., Dawson—Dawson Oil Mill, is taking bids for the construction of a seed house and addition to plant. Estimated cost $45,000. Architect not announced.

Tex., Fort Worth—Transcontinental Oil Co., Muskogee, Okla., will build an oil refinery, here, by day labor. Plans include 14 new filters, extension to barrelling and compounding plant, installation of a continuous treating system, new clay burner buildings, with equipment. A. J. Slagter, Gen. Mgr. is architect and engineer.

Far West

Ariz., Winslow — City, is having plans prepared for the construction of a gas plant. The plans include a 150,000 cu.ft. gas holder; 10,000 cu.ft. per hour capacity, oil gas generator with scrubbers; 6,000 cu.ft. per hour gas booster; purification set; 80 hp. return tubular fire box; 2 lampblack filters; etc. Estimated cost $50,000. Bonds have been voted to finance the project.

Calif., Fresno—Sun Maid Raisin Growers' Association, Holland Bldg., have engaged Trewhitt Shields Co., Pacific Southwest Bldg., as managers of construction, for four buildings, to be built here, for a syrup plant. Shields, Fisher and Lake are engineers and architects. The total estimated cost is $500,000.

Calif., Glendale—Titania Chemical Co., awarded contract for the construction of a 70 x 300 ft. chemical plant, to Moran & Co., Kerchkoff Bldg., Los Angeles. Estimated cost $200,000. Equipment will be required.

Calif., Kingsburg—City trustees, C. R. Magnuson, Clk., plans the construction of a gas plant, to serve a population of 2,000. Owners are interested in prices of construction and equipment.

Calif., Merced—American Canned Products Co., A. Moore, Pres., 756 South Broadway, Los Angeles, plans the construction of a tomato canning plant, with complete equipment, here. Estimated cost $100,000.

Calif., Sacramento—Northwestern Sugar Refining Co., Bank of Italy Bldg., Oakland, is having plans prepared for the construction of a beet sugar refinery, on Kiesel St., here. Estimated cost $1,500,000. W. H. Ellison, Pacific Bldg., San Francisco is engineer.

Utah, Salt Lake City—Studebaker Wulff, Rubber Co., 1028 Continental Bank Bldg., plans the construction of a factory and distributing plant, here. Estimated cost $500,000. S. W. Winburn is architect.

Canada

N. B., Grand Falls—International Paper Co., 100 East 42nd St., New York, is reported to be considering the construction of a plant on the St. John River near here. Estimated cost $6,000,000.

Ont., Frood—Mond Nickel Co., Coniston, plans the construction of a 35 x 105 ft. drying building and 30 x 120 ft. machine shop at plant, here. Estimated cost $35,000. Company is interested in prices of all equipment. L. G. Ingolsfrud is company engineer.

Ont., Kagawong—Little Rapids Pulp Co., awarded contract for the construction of a 2 story pulp mill, on Manitoulin Island, to W. E. Ule, Stevens Point, Wis. Estimated cost $200,000. Equipment including saws, screens, conveyors, pulp grinders, wet machines, transmission machinery, etc.; also 1200 hp. and 500 hp. water wheels, 90 kw. generator will be required.

Ont., Kenora — The Backus Brooks Co., plans the construction of a one and two story, newsprint mill to increase the capacity of plant from 100 to 250 tons per day. Estimated cost $1,500,000. Newsprint machines, grinders, motors, etc., will be required. T. T. McLennan is engineer.

Ont., Kitchener—Ames Holdem Tire & Rubber Co., Ltd., T. H. Ainlay, Pur. Agt. is in the market for 65 in. metal calender shells.

Ont., Kitchener—Goodrich Rubber Co., is having plans prepared for the construction of factory additions. Estimated cost $100,000. Company engineers in charge. Additional equipment for manufacture of rubber products will be required.

Ont., Milton—Canadian Wood Impregnating Co. plans improvements to plant, and will require equipment including vats, tanks, pumps, chemicals, etc., for wood preservation and impregnation. Estimated cost of equipment $125,000.

Ont., Otterville—Hyslop & Sons, Burlington, plan the construction of a canning factory, here. Estimated cost $40,000. Prices wanted on complete equipment.

Ont., Port Stanley — Williams Canning Co., Ltd., F. E. Williams, Gen. Mgr., 425 Dundas St., London, is in the market for complete equipment for canning plant, here. Estimated cost $50,000.

Ont., Toronto—A. R. Clarke & Co., Ltd., 633 Eastern Ave., plans the construction of a 2 story, addition to tannery and leather plant on Eastern Ave. Estimated cost $160,000. Equipment including wood vats, will be required. M. Parker, 633 Eastern Ave., is engineer.

Ont., Toronto — Consumers Gas Co., 55 Adelaide St., East, plans addition to gas plant to increase output from 15,000,000 to 20,000,000 cu.ft. capacity. Equipment for the manufacture of gas, coke and byproducts, will be required. Estimated cost $500,000.

Ont., Toronto — Hydro Electric Power Commission, 190 University Ave., plans the construction of a coking plant, in connection with auxiliary power plant. Total estimated cost $5,000,000. F. A. Gaby, 190 University Ave., is chief engineer.

Ont., Walkerville—Berry Bros., Frederick Colby, Mgr., plans to rebuild varnish and paint factory to replace fire loss. Estimated cost $100,000.

Ont., West Lorne — Dominion Canners, Ltd., Hamilton, J. A. Fuller, Mgr., plans the rebuilding of cannery, destroyed by fire, here. Estimated cost $100,000. Owners are in the market for complete equipment.

Que., Bromptonville—Bromptonville Pulp and Paper Co., Ltd., M. McCrea, plans the construction of a pulp mill. Estimated cost $500,000. Architect's name withheld.

Australia, Melbourne—Victorian Government Railway Board, will receive bids until May 6 for supply and delivery of self contained portable, petrol engine driven, electric welding plant, complete with accessories and spares.

Incorporations

Textile Rubber Co., Groton, Conn., manufacture rubber compositions, $40,000. J. S. Sanford, S. M. Sanford, C. E. Wheeler, J. R. Wheeler, and the Standard Machinery Co., Mystic.

Eastern Oil Products Co., Wilmington, Del., $40,000. (Corporation Service Co.)

Schutter Johnson Candy Co., of New York, Wilmington, Del., $625,000. (Corporation Trust Co. of America).

Continuous Tunnel Kiln Corp., Dover, Del., ceramic, $1,000,000.

Scalite Manufacturing & Chemical Co., $100,000, Dover, Del.

Midcontinent Portland Cement Co., Wilmington, Del., $11,000,000. (Delaware Charter Co.)

Hubbard Doyle Laboratories, Dover, Del., food products, $100,000. J. Dannenberg, New York, (Delaware Registration and Incorporators Co.)

Neo Chroma, Wilmington, Del., chemists, druggists, oil color, $400,000. (Colonial Charter Co.)

Continental Development and Reduction Corporation, Dover, Del., oils, $3,000,000. (Corporation Trust Co. of America.)

Ohio Gasoline Co., Wilmington, Del., petroleum, $100,000. (Delaware Registration Trust Co.)

Mica Products Corporation, Wilmington, Del., $1,000,000. (Corporation Service Co.) Maxon-Hughes Corporation, New York, N. Y., fillers and varnishes, $100,000. P. J. Maxon, J. H. Hughes, H. G. Wacker. (Attorneys, Marvin & Pleasants, 150 Broadway.)

Wilson Petroleum Corp., Wilmington, Del., petroleum, $5,000,000. (Corporation Trust Co. of America).

International Oils Ltd., Wilmington, Del., $1,500,000. (Corporation Service Co.)

Watson Bark Co., Sanford, Me., manufacture dyes and chemicals, preferred stock, $25,000, common stock, $75,000. F. Watson, H. F. Shepard, J. V. Tucker.

Towle Process Co., Augusta, Me., process for making and repairing patent leather, $100,000. G. M. Towle, Hallowell, Pres.

Welco Products, Inc., Boston, Mass., soap products, $100,000. R. D. O'Keefe, G. Hunter, Stoneham, M. A. Siebert, J. F. Welch, Boston, H. P. Connell, Winchester.

Newton Glass Co., Newton, Mass., glass manufacture, 1,000 shares of common stock, no par value. L. L. Frederick, M. M. Ryan, G. M. Frederick, Belmont.

Old Colony Soap Co., Boston, Mass., manufacture soap, $50,000. T. W. Morris, W. P. Evarts, Brookline, K. MacDonald.

Bay State Japanning Co., Woburn, Mass., treating leather, $10,000. I. O. Cornelisusen, C. E. Erickson, W. Widen.

Joseph Miller, Inc., Boston, Mass., rubber goods, 1,300 shares of no par value. J. Miller, H. J. Gerngold, A. Abalman.

Sunbrite Paint and Wall Paper Co., Newark, N. J., $125,000. S. Zorn, C. Martin, Newark; I. Luckovsky, New York. (Attorney, Fast & Fast, Newark.)

Pfeiffer Color Co., Newark, N. J., $100,000. K. F. Stover, H. R. Lewis, A. C. Ullrich. (Attys., Linott, Kahrs & Young, Newark).

Black Diamond Graphite Corp., Fort Lee, N. J., 100 shares, no par value. L. C. Burdett, Palisades, F. Fornato, Brooklyn. (Atty., L. C. Burdett, New York).

Champion Pulp-Wood Corp., New York City, N. Y., 10,000 common shares, no par value, F. L. Carlisle, R. K. Ferguson, W. Versfelt. (Atty. F. J. Knorr, Albany).

Pyro Corrosanti World Syndicate, New York, N. Y., chemical laboratories, 1,000 common, no par value. A. Schor, S. F. Levy. (Atty., E. J. Levy, 1133 Broadway).

Autoaid Products Co., New York, N. Y., lubricants, $60,000. O. Scheibener, C. K. Sanborn, Jr., D. M. Miller. (Atty., F. E. Hamilton, 61 Broadway).

Lindsay Asbestos, Rochester, N. Y., rubber goods, 2,000 shares common, no par value. L. Lindsay, A. B. Curran, L. D. Mahoney. (Attys., Wile, Oviatt & Gilman, Rochester.)

Bell Oil Refining Co., Pittsburgh, Pa., increase capital from $50,000 to $400,000.

Parafin Oil Co., Dover, Del., natural gas, petroleum, $100,000.

Oneida Petroleum Co., Philadelphia, Pa., oil industry, $1,000,000. (Corporation Guarantee & Trust Co.)

Lake Cotton Oil Co., Dyersburgh, Tenn., $50,000. E. Rice, et al.

Petroleum Producing Co., Seattle, Wash., $6,000,000.

Penn Confectionary Co., Phillipsburg, Pa., manufacture candy, $100,000. C. D. Loriane, L. Baird, J. E. Fryberger.

Kulshan Candy Co., Dellingham, Wash., $50,000. P. N. Inge, D. N. Anderson.

Canadian Aroma Products, Ltd. c/o W. H. Biggar, 120 St. James St., Montreal, Que., manufacturers of chemicals, perfumes,, etc.